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The Euro-dollar market as a source of United States bank liquidity

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The Euro-dollar market as a source of United States bank liquidity

by

Steve B. Steib

A Dissertation Submitted to the
Graduate Faculty in Partial Fulfillment of
The Requirements for the Degree of
DOCTOR OF PHILOSOPHY

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LIST OF SYMBOLS USED

A:	a measure of liquidity
B:	borrowings from the Federal Reserve
b:	the interest rate on 90-day Euro-dollars
cb:	the interest rate on call Euro-dollars
c_0 :	the offer rate on CDs
c_s :	the secondary CD rate
CD:	certificates of deposit
CIPC:	cash items in the process of collection
D_1 :	a surrogate for the September 1969-January 1971 reserve free base definition
D_2 :	a surrogate for the post January 1971 reserve free base definition
DD:	net demand deposits
Δ :	the first difference operator
δ_1 :	the service charge rate on demand deposits
δ_2 :	the per unit cost of servicing demand deposits
E:	the expected value operator
e:	the reserve requirement ratio on Euro-dollar borrowings
E\$B:	Euro-dollar borrowings
E\$B*:	the optimal level of Euro-dollar borrowings
E\$B _b :	the reserve free base for Euro-dollar borrowings
F:	federal funds
f:	the interest rate on federal funds
G:	government securities

- g: the interest rate on government securities
- G_c : the German call rate
- G_1 : the German 90-day interbank loan rate
- K: fixed costs
- k: the Federal Reserve discount rate
- L: commercial bank loans
- λ_1 : weights in the liquidity definition
- p: the interest rate on commercial bank loans
- π : profits
- Q: the Regulation Q ceiling
- R: reserves
- r: the reserve requirement ratio on net demand deposits
- S: the measure of soundness
- s: the reserve requirement ratio on savings deposits and CDs
- SD: savings and time deposits
- T: the time trend
- t: the interest rate on savings and time deposits
- UK_c : the United Kingdom call rate
- UK_t : the United Kingdom Treasury bill rate
- w_1 : weights in the soundness definition
- X: $(g - b) + (c_0 - b) + (f - cb) + (k - cb)$

CHAPTER I

THE EVOLUTION OF AMERICAN BANK ACTIVITY
IN THE EURO-DOLLAR MARKETIntroduction: A Description of the Euro-dollar Market

There is an extensive body of descriptive literature dealing with the Euro-dollar market. Paul Einzig's The Euro-dollar System¹ contains a thorough description of the historical development and institutional framework of the market. The Euro-dollar Market², by E. Wayne Clendenning, is a policy-oriented monograph dealing with the Euro-dollar market. Most of the descriptive literature pertaining to the Euro-dollar market is found in the financial press rather than in professional journals or monographs.

The term "Euro-dollar" refers to dollar-denominated deposits held in banks outside the United States, including such deposits in foreign branches of United States banks. These Euro-dollar balances are not limited to European banks, despite what one might infer from the term "Euro-dollar."

The Euro-dollar market might best be viewed as a wholesale market for dollars among banks outside the United States. This market is well-developed in many parts of the world, with major Euro-

¹Paul Einzig, The Euro-dollar System (New York: St. Martin's Press Inc., 1967).

²E. Wayne Clendenning, The Euro-dollar Market (Oxford: Oxford University Press, 1970).

dollar markets existing in London, Paris, Frankfurt, Amsterdam, Zurich, Basle, Geneva, Milan, Vienna, Beirut, Tel-Aviv, Cairo, Liverpool, and Tokyo. The London market is by far the largest and most active.³

Due to the international nature of the Euro-dollar market most Euro-dollar business transactions are executed by the foreign exchange departments of the various banks involved. The familiarity of foreign exchange department personnel with the business standings of foreign banks facilitates rapid transactions of unsecured telephone lending and borrowing. The typical transaction is between two foreign exchange departments; however, the services of Euro-dollar brokers are also used.

The Euro-dollar market has been recognized as such only since 1957, even though deposits in terms of foreign currencies far antedate this year. There is evidence that transactions at medieval fairs included payments out of and into foreign currency deposits,⁴ and a substantial business in dollar and sterling deposits emerged in Berlin and Vienna in the 1920s.⁵ The Euro-dollar market is a new development only in that it constitutes a broad international market in foreign currency deposits and involves an international

³"The Euro-Currency Business of Banks in London," Bank of England Quarterly Bulletin, Volume X (March, 1970), 32.

⁴Einzig, The Euro-dollar System, pp. 3-5, Paul Einzig, The History of Foreign Exchange (London, Macmillan and Co., Ltd., 1962), pp. 70-73.

⁵Jane Sneddon Little, "The Euro-dollar Market: Its Nature and Impact," Federal Reserve Bank of Boston, New England Economic Review, May/June 1969, p. 4.

structure of interest rates, largely independent of any single nations domestic rates.

The origins of the modern Euro-dollar market can generally be traced to the early post World War II period. After World War II, the United States held most of the world's monetary gold reserves, and of necessity other countries held foreign currency (particularly dollars and pounds sterling) as part of their official reserve assets. Due to the reconstruction policies of the postwar period, and the fact that the United States remained the world's largest exporter, the dollar became the world's strongest and most freely convertible currency. The dollar evolved as an acceptable means of international payment and as the world's most important reserve asset.⁶

Since much of the balance-of-payments deficit of the early post-World War II era resulted from United States Foreign Aid under the Marshall plan, many dollars were transferred directly to the accounts of foreign official monetary institutions. These institutions began seeking investment opportunities for a portion of their dollar balances and were able to place these balances in the New York money market banks. The New York banks were experiencing high loan demand from the European private sector where dollars were being used to finance international trade. Even though the New York money market banks acted to channel most of the dollar investments of foreign official monetary

⁶For a discussion of whether the U. S. position as a reserve currency country is a blessing or a curse see: Robert Z. Aliber, "The Costs and Benefits of the U. S. Role as a Reserve Currency Country," Quarterly Journal of Economics, Volume LXXVII (August, 1964), 442-56.

institutions to private European borrowers during the 1950's, a European market for dollar deposits was developing throughout this period.

This development was strongly reinforced in the 1950's when East European banks, influenced by cold war pressures, chose to deposit their dollar balances with their London and Paris correspondents rather than their New York correspondents. In 1957 the British, after a series of balance-of-payments crises, restricted the use of pounds sterling for financing non-sterling trade. At this point British bankers, attempting to maintain London's position of eminence in international finance, actively sought to develop a London market for dollar deposits. By 1958, when most currencies had become freely convertible due to the removal of post-World War II exchange controls, an active Euro-dollar market had been developed in London.

The persistence and growth of the Euro-dollar market was stimulated by interest rate differentials between various national credit systems.⁷ Unless rates on Euro-dollar deposits are higher than rates on dollar deposits in the United States, and unless Euro-dollar loan rates are lower than rates on domestically available credit, there is little reason for people either to hold Euro-dollar deposits or demand Euro-dollar loans. If depositors can receive a higher return on their dollar deposits in the United States than in the Euro-dollar market, few will choose to make Euro-dollar deposits. If borrowers can borrow

⁷For a discussion of interest rate differentials and international capital flows see: Patric H. Hendershott, "The Structure of International Interest Rates: The U. S. Treasury Bill Rate and the Euro-dollar Deposit Rate," The Journal of Finance, Volume XXII (September, 1967), 455-65.

domestic currency and buy dollars in the foreign exchange market more cheaply than they can borrow Euro-dollars, then few will choose to borrow in the Euro-dollar market. Euro-dollar loan rates must also compete with United States rate offerings when United States financial institutions are free to offer loans internationally.

The United States deposit rates, therefore, set lower limits on Euro-dollar deposit rates; however, the United States loan rates only approximate the upper limits of the Euro-dollar loan rates. Since United States banks, unlike European banks, often require loan customers to maintain compensatory balances, the "effective" United States loan rate as viewed by European borrowers is approximately 20 percent above the nominal United States loan rate. It should also be noted that many European borrowers who might be allowed the prime rate in Europe cannot obtain the prime rate when borrowing in the United States.

Since the executive order of 1965 extended the application of the Interest Equalization Tax of 1964 to short-term non-export loans to foreigners made by United States banks, Euro-dollar loan rates have been less affected by United States loan rates. Euro-dollar loan rates have been able to rise as high as domestic loan rates.

When the major trading nations of the world removed their post-World War II exchange controls in 1958 the Euro-dollar market was free to expand. The existence of the requisite rate differentials was a major force in the expansion which followed the return to freely convertible currencies. During the 1958-59 period Regulation Q ceilings

of 2-1/2 percent applied to 90-180 day deposits, while the Euro-dollar deposit rates were at levels of 3-7/8 to 4 percent. United States banks were charging an "effective" loan rate of 5-3/4 percent, while Euro-dollar banks were offering loans at 4-1/2 to 5 percent. Domestic rates in Europe were high due to boom conditions, and the Euro-dollar market became a very popular financial institution. By 1960 the Euro-dollar market had attained a size of approximately one billion dollars.

From the outset of the Euro-dollar market a major portion of the Euro-dollar deposits came from foreign official dollar deposits redeposited in European commercial banks. It is estimated that around the middle of 1962 these official deposits accounted for two-thirds of all Euro-dollar deposits. These deposits continue to constitute the major source of funds in the Euro-dollar market. The second most important suppliers of funds to the Euro-dollar market are commercial banks, which hold Euro-dollar deposits on behalf of their clients as well as their own deposits acquired in connection with interest arbitrage. This is not to say, however, that European banks reduce their dollar working balances in New York banks in favor of Euro-dollar deposits. These working balances are necessary to insure dollar liquidity and to facilitate international financial transactions.

In addition to the foreign official institutions and foreign commercial banks, large firms of international standing having significant business in the United States are also major Euro-dollar depositors. Of particular importance among this group are insurance companies, oil companies, and the major tobacco companies. Foreign

subsidiaries of United States firms were also large Euro-dollar depositors until 1965, when they were required by the Direct Foreign Investment Program to repatriate these balances. While insurance companies are usually Euro-dollar depositors, the other firms are borrowers as often as they are depositors.

In the 1960's, particularly during and after 1966, the London and Paris branches of large United States banks constituted the most important group of Euro-dollar borrowers. They used some of these funds to finance European subsidiaries of United States firms and to finance international trade, but the most significant part of these funds were lent to their parent banks in the United States where they were used to finance domestic trade. United States banks have continued to borrow Euro-dollars from their foreign branches, and it is this practice, together with its monetary policy implications, which is the topic of this study.

The Euro-dollar Market and Domestic
United States Monetary Policy⁸

The borrowing of Euro-dollars by United States banks is relevant to United States domestic monetary policy in that these borrowed funds have, at times, been used as a source of excess reserves during

⁸Several descriptive articles have been published dealing with this topic, for instance: Fred H. Klopstock, "Euro-dollars in the Liquidity and Reserve Management of United States Banks," Federal Reserve Bank of New York, Monthly Review, Volume L (July, 1968) 130-138. Andrew F. Brimmer, "Euro-dollar Flows and the Efficiency of U. S. Monetary Policy," (paper presented before a conference on Wall Street and the Economy 1969 at the New School for Social Research, New York, Board of Governors of the Federal Reserve System, March 8, 1969).

periods of tight domestic monetary policy. During the tight money periods of the past decade the Euro-dollar market has evolved as an important source of funds for United States banks. During the 1966 tight money period, United States banks increased their Euro-dollar borrowings from overseas branches by \$2.7 billion, from \$1.6 billion in January 1966 to \$4.3 billion in November of 1966. During the tight money period of the first half of 1969 their borrowings increased by 92 percent, from \$7.5 billion in January 1969 to \$14.4 billion in July of 1969. By June of 1969 Euro-dollar borrowings of large New York banks reached a total of more than twice that of their outstanding CDs.

The Euro-dollar market has been recognized as an avenue through which United States banks have been able to cushion the effects of restrictive domestic monetary policy by increasing their excess reserves. At times when domestic money rates have exceeded Regulation Q ceilings, United States banks with foreign branches have been able to bid aggressively for funds in the Euro-dollar market because funds acquired by foreign branches are not subject to Regulation Q ceilings.

When the foreign branch of a United States bank borrows Euro-dollars for its parent, the lending bank is instructed to have its United States correspondent transfer the amount of the loan to the branch's account in its parent bank. This transfer is executed by means of a cashier's check and the parent bank's "cash items in the process of collection" (C.I.P.C.) is increased. This increase in C.I.P.C. reduces the net demand deposits against which reserves

are required of the parent bank. "Cash items in the process of collection and due from other banks" is deducted from gross demand deposits when computing required reserves to avoid holding banks responsible for reserves on deposits before they have received the cash transfers which correspond to these new deposits. Thus Euro-dollar borrowings increase the "cash items in the process of collection and due from other banks" of the parent bank in addition to transferring funds from demand deposits of one United States bank to "due to own foreign branches" of the parent bank. At times the reduction in an individual bank's gross demand deposits due to increases in C.I.P.C. has not been offset at the time of Euro-dollar repayment. The accounting positions of the banks involved in this Euro-dollar transaction are depicted in Chart 1.1. Part A of Chart 1.1 depicts the bank positions while the Euro-dollar transaction is being cleared, and Part B depicts their positions after clearing.

The effects on excess reserves of these transactions have varied as the Federal Reserve System has amended reserve requirements on Euro-dollar borrowings as specified in Regulations D and M. For descriptive purposes these effects will be categorized into four periods: the pre-July 1969 period; the July 1969-September 1969 period, the September 1969-January 1971 period, and the post-January 1971 period.

The Pre-July 1969 Period

Prior to the Amendment to Regulation D of July 31, 1969, Euro-dollar borrowing activities by U. S. banks were virtually free from reserve related regulation. Parent bank liabilities to foreign

Chart 1.1

The Accounting of Euro-dollar Borrowings

Part A

U. S. Parent Bank		Foreign Branch		Foreign Bank		U. S. Correspondent of Foreign Bank	
CIPC + x	+ x Due to own foreign branches	Due + x from parent bank	+ x Due to foreign bank	Deposits with U. S. correspondent - x			- x Demand deposit of foreign correspondent
				Loans to foreign branches + x			+ x Cashiers check outstanding

Part B

Reserves + x	+ x Due to own foreign branches	Due + x from parent bank	+ x Due to foreign bank	Deposit with U. S. correspondent - x		Reserves - x	- x Demand deposit of foreign correspondent
				Loans to foreign branches + x			

branches were not subject to reserve requirements. During this period Euro-dollar borrowings reduced the demand deposits of the lender's United States correspondent and thus reduced this bank's excess reserves by one minus the reserve ratio times the amount of the Euro-dollar borrowings $([1-r]x)$. The parent bank's excess reserves were increased by the full amount of the Euro-dollar borrowings (x) , while the banking system's excess reserves were increased by an amount equal to the demand deposit reserve requirement ratio times the amount of the Euro-dollar borrowings $(-[1-r]x + x = rx)$.

Insofar as Euro-dollar borrowings allowed the banking system to acquire increased totals of earning assets from a given quantity of reserves, they were similar to other nondeposit sources of funds such as Federal funds; however, Euro-dollar borrowings had other advantages which also made them attractive to bankers seeking excess reserves. Funds acquired through Euro-dollar borrowings (net liabilities of parent banks to their own foreign branches) were not and are not subject to FDIC fees. The time required to clear fund transfers among United States banks, particularly in cases involving the New York Clearing House, afforded an additional advantage to Euro-dollar borrowings as compared to other sources, which are quickly cleared by wire. The reduction in net demand deposits of the parent bank, which resulted from interbank fund transfers executed with cashier's checks, converted required reserves to excess reserves for the duration of the clearing period (usually one day). Short-term additions to the excess reserves of the parent bank

(and thus the banking system) were created by this increase in "cash items in the process of collection and due from other banks" in amounts equal to the demand deposit reserve ratio times the quantity of Euro-dollar borrowings (rx). Thus parent banks received a bonus when borrowing Euro-dollars, and they were able to avoid offsetting these reductions in reserve requirements by repaying their liabilities to foreign branches with bills payable checks (or officer's checks) which, unlike cashier's checks, were excluded from demand deposits subject to reserve requirements. By borrowing overnight Euro-dollars daily ("rolling over" their overnight Euro-dollar borrowings), banks were able to maintain levels of "due from other banks" and thus convert their short-term benefit into a permanent one.

The July 1969-September 1969 Period

Amendment D was amended as of July 31, 1969 "to insure that officer's checks issued by a member bank or by or on behalf of a foreign branch of a member bank on an account maintained by such branch with a domestic office of the parent bank are included by the member bank as deposits for purposes of computing its reserve requirement."⁹

After July of 1969 parent banks were no longer able to avoid offsetting the reductions in net demand deposits associated with Euro-dollar borrowings. The clearing process bonus associated with Euro-

⁹See Appendix B for the text of the Amendments to Regulations D and M.

dollar borrowings was eliminated by requiring banks to include officer's checks in gross demand deposits during the clearing of Euro-dollar repayments.

The September 1969-January 1971 Period

The September 4, 1969, Amendments to Regulations D and M placed a 10 percent marginal reserve requirement on parent banks' net liabilities to their foreign branches in excess of the parent bank's Euro-dollar borrowing base. This base was defined as the parent bank's average-daily outstanding net liabilities to its foreign branches in the four-week period ending May 28, 1969.

The reserve requirement on demand deposits at large city banks (which are the banks that borrow in the Euro-dollar market) has been fixed at 17-1/2 percent since April 17, 1969. During the period from September 1969 to January 1971 Euro-dollar borrowings reduced the excess reserves of the lending bank's United States correspondent by 82-1/2 percent of the amount of the Euro-dollar borrowing. The parent bank's excess reserves were increased by 90 percent (100 percent minus the 10 percent reserve requirement on liabilities to own foreign branches). Thus the banking system experienced an increase in excess reserves of 7-1/2 percent (or the demand deposit reserve ratio, 17-1/2 percent, minus the Euro-dollar borrowings reserve ratio, 10 percent) of the Euro-dollar borrowings.

The 1969 Amendments to Regulations D and M represent attempts to control the excess-reserve creating aspects of Euro-dollar borrowings by United States banks. In June of 1970 Regulation Q ceilings were

removed from \$1,000,000 CD's in order to encourage United States banks to compete for funds in domestic markets rather than turning to the Euro-dollar market.

The Post-January 1971 Period

By the middle of 1969 United States banks had begun repaying their Euro-dollar borrowings in mass quantities, and many banks were eroding their reserve-free bases. Due to erosions of the United States official reserves balance of payments the Federal Reserve System amended Regulations D and M in January 1971 in order to retard this repayment of Euro-dollar borrowings. Regulations D and M were amended to increase the Euro-dollar reserve requirement to 20 percent and re-define the reserve-free base for Euro-dollar borrowings. This new definition incorporated a more inclusive automatic downward adjustment mechanism in order to discourage parent banks from eroding these reserve-free bases.¹⁰ Given the Euro-dollar marginal reserve requirement of 20 percent (which exceeds the 17-1/2 percent demand deposit reserve requirement), the banking system would experience a decrease in excess reserves when Euro-dollar borrowings exceed the reserve-free base. The borrowing bank would receive an addition to its excess reserves in an amount equal to only 80 percent of its Euro-dollar borrowings) and the lenders United States correspondents would experience a reduction in its excess reserves by an amount equal to 87-1/2 percent of the Euro-dollar borrowing.

¹⁰See Appendix B for the text of the Amendments to Regulation D and M.

The 1971 Amendments to Regulation D and M represent attempts to control Euro-dollar repayments because of their effects on the United States balance of payments. Both the Import-Export Bank and the United States Treasury made special securities available to foreign branches of United States banks in 1971 in order to remove dollars from foreign markets and thus improve the official reserve balance. The Treasury issue of April 1971 was made in conjunction with the Federal Reserve System's April, 1971 Amendment to Regulation M which allowed these securities to be included in the parent bank's reserve-free base.

Euro-dollar Borrowings and the United States
Balance of Payments¹¹

Although Euro-dollar borrowing activities by United States banks do not affect the United States balance of payments accounts in a direct accounting sense, they do have a highly significant effect on the United States balance of payments as computed on the official reserve transactions basis. This balance is the net dollar holdings of foreign official monetary institutions and it is often used as an indication of the international position of the dollar.

Since the Bretton Woods Conference of 1944, the members (now numbering 118 countries) of the International Monetary Fund (I.M.F.) have agreed to maintain relatively fixed exchange rates with respect

¹¹Several descriptive articles dealing with this topic have been published in the financial press, for instance: Joseph Kvasnicka, "Euro-dollars--An Important Source of Funds for American Banks," Federal Reserve Bank of Chicago, Business Conditions, June 1969, pp. 8-10.

to the dollar, and the United States has agreed to maintain a fixed exchange rate of \$35 per ounce between gold and the dollar. Foreign official monetary institutions have agreed to enter their foreign exchange markets as purchasers and suppliers of dollars in order to maintain exchange rate stability.¹²

When United States banks borrow heavily in the Euro-dollar market (increasing the demand for Euro-dollars) upward pressure is exerted on the Euro-dollar deposit rate. The Euro-dollar market offers an investment opportunity to foreign investors and has the potential of attracting dollars out of foreign exchange markets and foreign official monetary institutions. When rates on Euro-dollar deposits exceed foreign domestic rates, foreign-held dollars flow into the Euro-dollar market and foreign investors exchange their domestic currency for dollars which they place in the Euro-dollar market. These transactions reduce the supply of and increase the demand for dollars in foreign exchange markets; and, ceteris paribus lead foreign official monetary institutions to purchase their domestic currencies with dollars, thus reducing their dollar assets and improving the official reserve transactions basis of the United States Balance of Payments.

As United States banks repay large quantities of Euro-dollars (increasing the supply of Euro-dollars) a downward pressure is exerted on the Euro-dollar rate, which, ceteris paribus, leads to a flow of

¹²As this study is being completed the Bretton Woods Agreements are in suspension and attempts are being made to revise the international payments mechanisms.

funds out of the Euro-dollar market and into foreign domestic markets. This flow of funds leads foreign official monetary institutions to purchase dollars for purposes of exchange stability, and these purchases adversely affect the official reserve transactions basis of the United States Balance of Payments. These effects are presented in Charts 1.2 and 1.3.

Scope of the Study

United States bank behavior in the Euro-dollar market has become a topic of major concern to United States policy makers. It is the objective of this study to analyze the theoretical and empirical economic determinants of Euro-dollar borrowings by United States banks. A theoretical derivation and empirical tests of the demand function of United States banks for Euro-dollar borrowings will be presented. The empirical examination is applied to the period from December 31, 1964, to April 28, 1971.

Chart 1.2

**Euro-dollar Borrowings and Improvement in the
Official Reserves Transactions Basis of the
United States Balance of Payments**

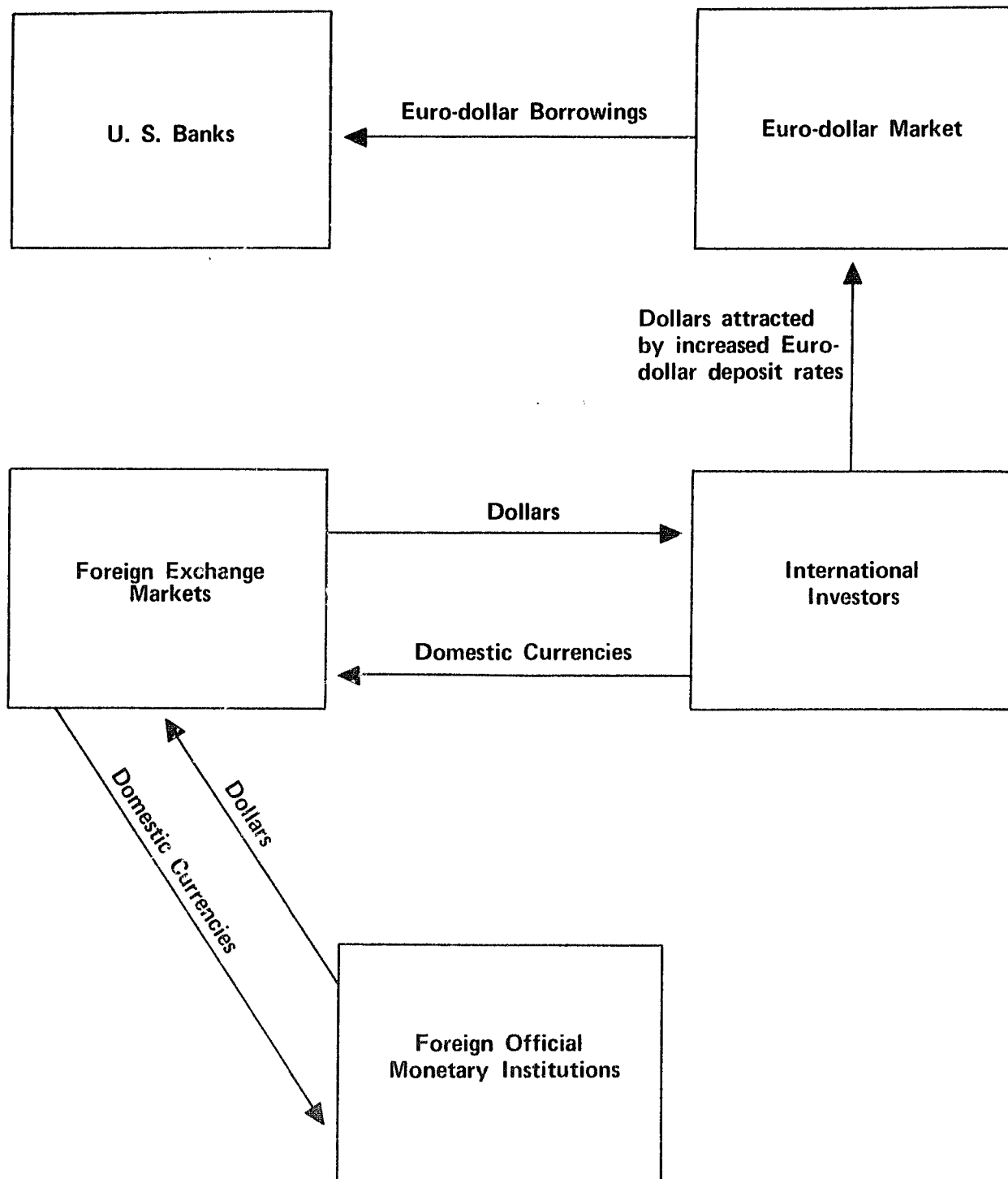
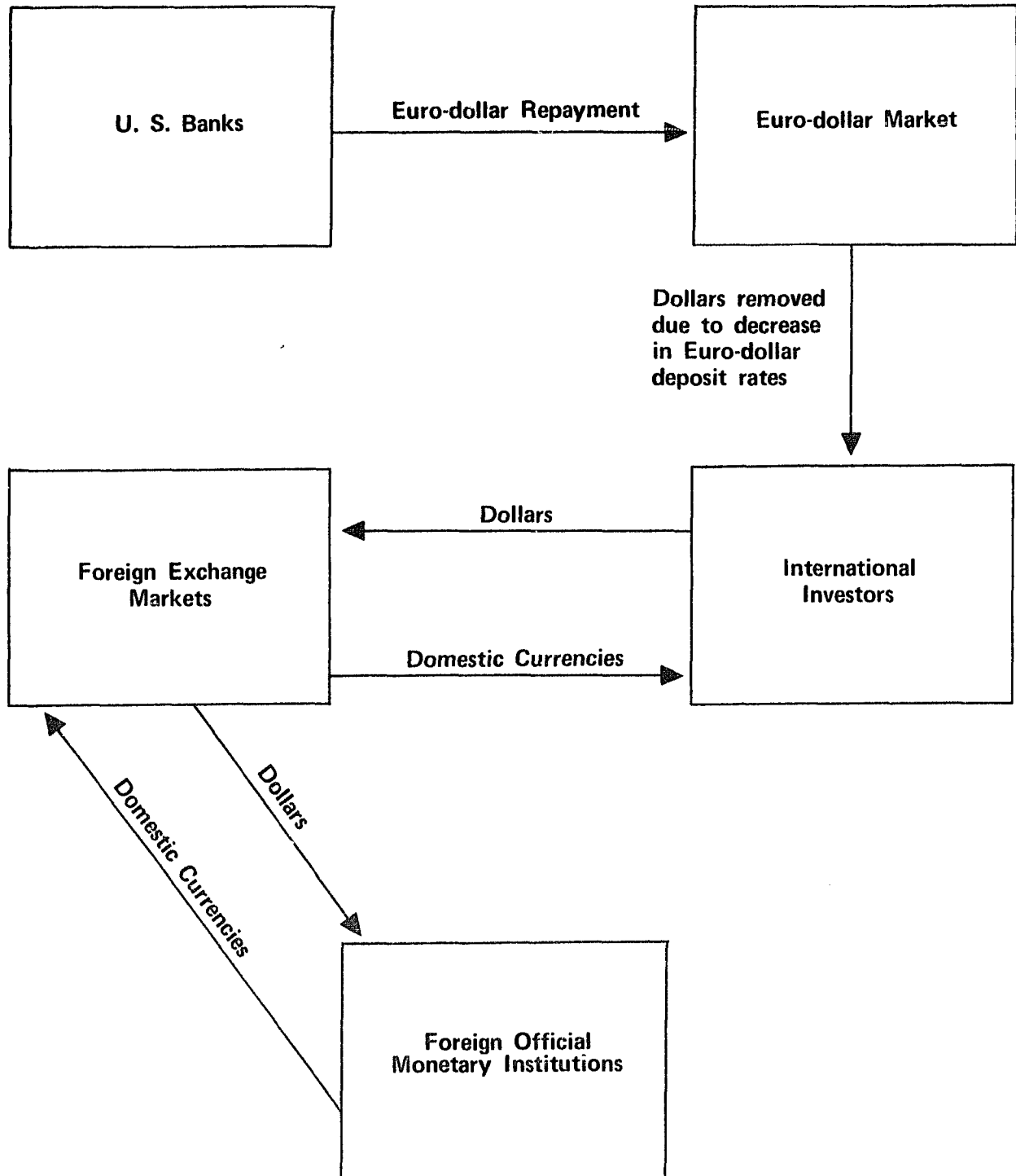


Chart 1.3

**Euro-dollar Repayments and Worsening of the
Official Reserve Transactions Basis of the
United States Balance of Payments**



CHAPTER II

THE THEORETICAL MODEL

The model used in this study derives from the work of Dudley Luckett¹ and Carl Vander Wilt.² Luckett's analysis is concerned with the customer relationship, while Vander Wilt's is concerned with determinants of member bank borrowings from the Federal Reserve; however, both of these studies use a microeconomic portfolio optimization approach as the theoretical model with which to analyze bank behavior.

Bryan and Aigner have argued that the literature concerned with short-run bank behavior may be grouped into two categories: that which considers the bank as a microeconomic unit in the traditional theory of the firm and develops models of optimization; and that which makes use of the traditional stock adjustment model.³ The model used in this study combines a microeconomic analysis with a stock adjustment model in order to analyze the behavior of individual banks as Euro-dollar borrowers. It is a stock adjustment model

¹Dudley G. Luckett, "Credit Standards and Tight Money," Journal of Money, Credit and Banking, Volume II (November, 1970) 420-34.

²Carl Eugene Vander Wilt, Member Bank Borrowing: A Microeconomic Approach, (unpublished thesis, Iowa State University, 1968).

³Dennis J. Aigner and William P. Bryan, "A Model of Short Run Bank Behavior," The Quarterly Journal of Economics, Volume LXXXV (February, 1971) 97-99.

with the desired level of Euro-dollar borrowings determined by a utility maximization assumption with profit, liquidity and soundness as arguments in the utility function.

The banker is assumed to formulate a desired level of Euro-dollar borrowings, $E\$B_t^*$, based on the position of his bank at $t-1$. In order to maximize utility and thus reach equilibrium the banker must reach a level of Euro-dollar borrowings equal to $E\$B_t^*$ at time t ; therefore his utility maximizing change in Euro-dollar borrowings between $t-1$ and t must be $E\$B_t^* - E\B_{t-1} . The banker may be unable to reach equilibrium in a single time period in which case his change in Euro-dollar borrowings is some fraction of $E\$B_t^* - E\B_{t-1} .

Changes in Eurodollar borrowings may be expressed as:

$$(1) \quad \Delta E\$B = \gamma(E\$B_t^* - E\$B_{t-1}) \quad 0 \leq \gamma \leq 1$$

or

$$(2) \quad E\$B_t - E\$B_{t-1} = \gamma E\$B_t^* - \gamma E\$B_{t-1}$$

which is algebraically equivalent to:

$$(3) \quad E\$B_t = \gamma E\$B_t^* + (1 - \gamma)E\$B_{t-1} \quad 0 \leq \gamma \leq 1$$

where:

$\Delta E\$B$ = the actual change in Euro-dollar borrowings between $t-1$ and t ,

$E\$B_t^*$ = the desired level of Euro-dollar borrowings at t ,

$E\$B_{t-1}$ = the actual level of Euro-dollar borrowings at $t-1$,

γ = the fraction by which the banker is able to adjust to equilibrium in a single period.

Changes in Euro-dollar borrowings are a function of desired levels of Euro-dollar borrowings, and to specify these desired levels a model of the individual bank must be developed.

A simplified balance sheet identity for an individual bank may be specified as:

$$(4) \quad R + G + L = DD + SD + CD + F + B + E\$B$$

where:

R = reserves,

G = government securities,

L = loans,

DD = net demand deposits,

SD = time and savings deposits,

CD = certificates of deposit,

F = federal funds,

B = borrowings from the Federal Reserve,

E\$B = Euro-dollar borrowings.

and:

$$R, G, L, DD, SD, CD, B \geq 0; F, E\$B \geq 0.$$

If it is assumed that banks hold zero excess reserves, reserves may be expressed as:

$$(5) \quad R = r(DD) + e(E\$B - E\$B_b) + s(SD + CD)^4$$

where:

$E\$B_b$ = the reserve free Euro-dollar borrowings base,

r = the reserve requirement ratio on net demand deposits,

s = the reserve requirement ratio on time and savings deposits,

e = the marginal reserve requirement on Euro-dollar borrowings.

⁴This reserve equation is applicable to the post-July 1969 period and will be used throughout the development of this theoretical model.

By substituting (5) into (4) and simplifying:

$$(6) \quad G + L = (1 - r)DD + (1 - s)(SD + CD) + (1 - e)E\$B \\ + eE\$B_p + F + B$$

The banker is assumed to manage his assets and liabilities in order to maximize the utility function,

$$(7) \quad U = u(\pi, S, A)$$

where:

π = profit,

S = soundness,

A = liquidity.

Profit

Profits are equal to total revenue minus total costs and total revenue may be expressed as:

$$(8) \quad TR = gG + pL + \delta_1 DD$$

where:

TR = total revenue,

g = the interest rate on government securities,

p = the interest rate on loans,

δ_1 = the service charge rate on demand deposits.

Total costs may be written as:

$$(9) \quad TC = \delta_2 DD + tSD + cCD + fF + kB + bE\$B + K$$

where:

TC = total costs,

δ_2 = the cost of servicing demand deposits,

t = the interest rate paid on time and savings deposits,

- c = the interest rate paid on certificates of deposit,
- f = the interest rate paid on federal funds,
- k = the interest rate paid on Federal Reserve borrowings,
- b = the interest rate paid on Euro-dollar borrowings,
- K = fixed costs including the cost of servicing loans.

By assuming that the cost of servicing demand deposits is equal to the service charge on demand deposits (i.e., $\delta_1 = \delta_2$) profits can be expressed as:

$$(10) \quad \pi = gG + pL - tSD - cCD - fF - kB - bE\$B - K$$

Liquidity

The banker is concerned with liquidity because of his desire to meet obligations which will come due between the current period, t , and his planning horizon, $t+h$. These obligations include deposit withdrawals, redemption of maturing certificates of deposit, loan requests,⁵ repayment of borrowings from the Federal Reserve, repayment of matured federal funds borrowings, and repayment of matured Euro-dollar borrowings. At time t the banker is certain about the portion of borrowings from the Federal Reserve, certificates of deposit, federal funds borrowings, and Euro-dollar borrowings which will come due between t and $t+h$. The banker must form subjec-

⁵The loan requests referred to in this model are those which the banker chooses to meet. For a discussion of the customer relationship and the banker's decision to deny or meet loan requests see: Donald R. Hodgeman, Commercial Bank Loan and Investment Policy (University of Illinois, 1963) pp. 154-58. Duane Harris, "Rationing Credit to Business, More than Interest Rates," Federal Reserve Bank of Philadelphia, Business Review, August 1970, pp. 3-14. Luckett, "Credit Standards and Tight Money."

tive expectations concerning the levels of loan requests and deposit withdrawals during the planning horizon. Maturing obligations constitute uses of funds for the banker and are the source of his concern with liquidity.

Sources of funds which are available to the banker include government security liquidation, the collection of matured loans, the sale of certificates of deposits, new borrowings from the Federal Reserve, new federal funds borrowings, increases in deposits, new Euro-dollar borrowings, and those reserves freed by deposit withdrawals. If loan default is ignored, the banker is certain about the portion of his loan portfolio which will be repaid during the planning horizon. He must make subjective expectations about the levels of federal funds borrowings, deposits, certificates of deposit, borrowings from the Federal Reserve and Euro-dollar borrowings which will exist at $t+h$. The banker has some control over these levels but his expectations will be formed on the basis of various expected interest rates and regulations. For instance the difference between the Regulation Q ceiling rate on certificates of deposit and the secondary CD rate will affect the bankers expectations regarding CD issues between t and $t+h$, and thus the expected level of CD holdings at $t+h$.

The definition of bank liquidity used here is based on the difference between sources and uses of funds. Liquidity is defined as follows:

$$(11) \quad G_t - \lambda_1 CD_t + E\Delta CD - \lambda_2 B_t + E\Delta B - \lambda_3 F_t + E\Delta F - \lambda_4 (1-e)E\$B_t$$

$$\begin{aligned}
& + E(1-e)\Delta E\$B + \lambda_5 L_t - E\Delta L - E\lambda_6(1-r)\Delta DD + E(1-r)\Delta DD \\
& - E\lambda_7(1-s)SD + E(1-s)\Delta SD - A\sigma = 0
\end{aligned}$$

which may be written as:

$$\begin{aligned}
(12) \quad G_t + \lambda_5 L_t + E[\Delta CD + \Delta B + \Delta F + (1-e)\Delta E\$B + (1-r)\Delta DD \\
+ (1-s)\Delta SD - \lambda_6(1-r)DD_t - \lambda_7(1-s)SD_t - \Delta L] \\
- \lambda_1 CD_t - \lambda_3 B_t - \lambda_2 F_t - \lambda_4(1-e)E\$B_t - A\sigma = 0
\end{aligned}$$

where:

E = the expected value operator,

Δ = the change in the level of the indicated variable between t and $t+h$,

λ_1 = the proportion of certificate of deposit holdings at t which will be redeemed between t and $t+h$,

λ_2 = the proportion of federal funds borrowings at t which will be repaid between t and $t+h$,

λ_3 = the proportion of borrowings from the Federal Reserve at t which will be repaid between t and $t+h$,

λ_4 = the proportion of Euro-dollar borrowings at t which will be repaid between t and $t+h$,

λ_5 = the proportion of loans at t which will be collected between t and $t+h$,

λ_6 = the proportion of demand deposits at t which will be withdrawn between t and $t+h$,

λ_7 = the proportion of time and savings deposits at t which will be withdrawn between t and $t+h$,

σ = the standard deviation of the distribution of $[\Delta CD + \Delta B + \Delta F + (1-e)\Delta E\$B + (1-r)\Delta DD + (1-s)\Delta SD - \lambda_6(1-r)DD_t - \lambda_7(1-s)SD_t - \Delta L]$,

A = the measure of liquidity.

If we assume that the expectations in Equation (12) are distributed with known mean and standard deviation then A is the only

unknown in (12). This is the number of standard deviations by which $E[\Delta CD + \Delta B + \Delta F + (1-e)\Delta E\$B + (1-r)\Delta DD + (1-s)\Delta SD - \lambda_6(1-r)DD_t - \lambda_7(1-e)SD_t - \Delta L]$ may underestimate the actual level without causing the banker to be unable to meet his needs for liquid funds.

Suppose it is known that a banker expects, from t to $t+h$, to issue \$140 in new CDs, borrow \$100 from the Federal Reserve, borrow \$500 in federal funds, borrow \$700 in the Euro-dollar market, accept \$800 in demand deposits, accept \$115 in time and savings deposits, and meet \$750 worth of new loan demand.

Further assume that, between t and $t+h$, 5 percent of his CD holdings at t will mature ($\lambda_1 = .05$), all of his borrowings from the Federal Reserve at t must be repaid ($\lambda_2 = 1$), all of his federal funds borrowing at t must be repaid ($\lambda_3 = 1$), 60 percent of his Euro-dollar borrowings at t will mature ($\lambda_4 = .60$), and 5 percent of his loan portfolio at t will mature ($\lambda_5 = .05$). Suppose it is also known that the banker expects 30 percent of his demand deposits to be withdrawn between t and $t+h$ and 3 percent of his savings and time deposits are expected to be withdrawn ($\lambda_6 = .30$ and $\lambda_7 = .03$).

If the standard deviation of the distribution of $E[\Delta CD + \Delta B + \Delta F + (1-e)\Delta E\$B + (1-r)\Delta DD + (1-s)\Delta SD - \lambda_6(1-r)DD_t - \lambda_7(1-s)SD_t - \Delta L]$ were known, a measure of the banker's liquidity could be obtained from his current portfolio (at t). The following values constitute one possible example:

<u>Current portfolio</u>		<u>Expected changes</u>
$CD_t = 1,000$	$\lambda_1 = .05$	$E(\Delta CD) = -.05(1,000) + 150 = 50$
$F_t = 400$	$\lambda_2 = 1$	$E(\Delta F) = -1(400) + 500 = 100$

Current portfolioExpected changes

$B_t = 100$	$\lambda_3 = 1$	$E(\Delta B) = -1(100) + 100 = 0$
$E\$B_t = 1,000$	$\lambda_4 = .60$	$E(\Delta E\$B) = -.60(1,000) + 700 = 100$
$L_t = 5,000$	$E(\lambda_3) = .05$	$E(\Delta L) = -.05(5,000) + 750 = 500$
$DD_t = 3,000$	$E(\lambda_6) = .30$	$E(\Delta DD) = -.30(3,000) + 800 = -100$
$SD_t = 500$	$E(\lambda_7) = .03$	$E(\Delta SD) = -.03(500) + 115 = 15$

In this example the solution of Equation (12) yields $A\sigma = \$65$.

If we assume that $\sigma = \$65$ then $A = 1$. If the distribution is normally distributed the banker has adjusted his portfolio in a manner which assures him of being able to meet his liquidity needs 84 percent of the time. If the standard deviation of the distribution were \$32.50, A would be two. In this case the banker would be assured of meeting his liquidity needs 98 percent of the time, given the assumption of a normal distribution.

Soundness

The concept of soundness is used as a measure of the bank's ability to withstand unexpected changes in its liabilities and unexpected changes in the value of its assets. It is a measure of the bank's ability to meet its obligations to its customers in the event of forced liquidation due to unexpected events such as local or national economic contraction.

The definition of soundness used here is derived from the Federal Reserve's Form for Analyzing Bank Capital which is used to evaluate the bank's capital adequacy under assumed conditions of distress. This definition is expressed as the difference between the realizable value of the bank's assets in assumed periods of

contraction and an assumed maximum decline in liabilities which would accompany such a contraction.

$$(13) \quad S_t = R_t + w_2 G_t + w_3 L_t - w_4 CD_t - w_5 SD_t - w_6 DD_t \\ - B_t - F_t - E\$B_t$$

where:

S_t = the measure of soundness,

w_2 = the percentage of the current value of the bank's present holdings of government securities which would be realizable under the assumed conditions of distress,

w_3 = the percentage of the current value of the bank's present holdings of loans which would be realizable under the assumed conditions of distress,

w_4 = the percentage by which the bank's current CD liabilities might decline, through attrition, under the assumed conditions of distress,

w_5 = the percentage by which the bank's current time and savings deposits might decline under the assumed conditions of distress,

w_6 = the percentage by which the bank's current demand deposits might decline under the assumed conditions of distress.

Since R is a linear function of DD , $SD + CD$, and $E\$B - E\B_b , a weight (w_1) can be defined so that:

$$(14) \quad w_1 R = w_6 r(DD) + w_5 sSD + w_4 sCD + e(E\$B - E\$B_b)$$

and the substitution of (14) into (12) simplifies to:

$$(15) \quad S_t = w_2 G + w_3 L - w_6 (1-r)DD - w_5 (1-s)SD \\ - w_4 (1-s)CD - (1-e)E\$B - eE\$B_b - B - F$$

which is the specification of soundness to be used in this study.

Having specified a utility maximization model of bank behavior in which Euro-dollar borrowings enter the utility function through

their effects on profits, soundness and liquidity the desired, or equilibrium, levels of Euro-dollar borrowings must now be derived. The bank is viewed as having five alternative methods of acquiring needed reserves; liquidation of government securities, selling certificates of deposit, purchasing federal funds, borrowing from the Federal Reserve, and borrowing Euro-dollars.

The banker is assumed to have perfect knowledge with respect to his reserve needs, and it is assumed that these needs arise from increases in loan demand, withdrawals of demand deposits, and withdrawals of time and savings deposits. Differential calculus is used to derive the variables which the banker considers relevant when faced with reserve needs and the assumed means of adjustment.

The total derivative of the utility function describes the changes in utility for a given change in any or all of the variables. The total derivative of the utility function in this model may be expressed as:

$$(16) \quad du = \frac{\partial u}{\partial \pi} d\pi + \frac{\partial u}{\partial S} dS + \frac{\partial u}{\partial A} dA$$

Given that K is constant $d\pi$ reduced to:

$$(17) \quad d\pi = \frac{\partial \pi}{\partial G} dG + \frac{\partial \pi}{\partial L} dL + \frac{\partial \pi}{\partial SD} dSD + \frac{\partial \pi}{\partial CD} dCD + \frac{\partial \pi}{\partial F} dF + \frac{\partial \pi}{\partial B} dB \\ + \frac{\partial \pi}{\partial E\$B} dE\$B.$$

The total derivative of soundness is:

$$(18) \quad dS = \frac{\partial S}{\partial DD} dDD + \frac{\partial S}{\partial SD} dSD + \frac{\partial S}{\partial CD} dCD + \frac{\partial S}{\partial E\$B} E\$B + \frac{\partial S}{\partial E\$B_b} dE\$B_b \\ + \frac{\partial S}{\partial G} dG + \frac{\partial S}{\partial L} dL + \frac{\partial S}{\partial B} dB + \frac{\partial S}{\partial F} dF$$

By assuming σ constant $E[\Delta CD + \Delta B + \Delta F + (1-e)\Delta E\$B + (1-r)\Delta DD + (1-s)\Delta SD - \lambda_6(1-r)DD_t - \lambda_7(1-s)SD_t - \Delta L]$ constant, and the maturity structure of the banker's portfolio constant ($\lambda_1, \lambda_2, \lambda_3, \lambda_4$, and λ_5 constant) the total derivative of liquidity reduces to:

$$(19) \quad dA = \frac{\partial A}{\partial G}dG + \frac{\partial A}{\partial CD}dCD + \frac{\partial A}{\partial B}dB + \frac{\partial A}{\partial F}dF + \frac{\partial A}{\partial E\$B}dE\$B$$

The partial derivatives of Equations (17), (18), and (19) may be evaluated using Equations (10), (15), (12). The results are:

$$(20) \quad d\pi = gdG + pdL - tdSD - cdCD - fdF - kdB - bdE\$B$$

$$(21) \quad dS = w_2dG + w_3dL - w_6(1-r)dDD - w_5(1-s)dSD - w_4(1-s)dCD - (1-e)dE\$B - edE\$B_b - dB - dF$$

$$(22) \quad dA = \frac{1}{\sigma}[dG + \lambda_5dL - \lambda_1dCD - \lambda_2dF - \lambda_3dB - \lambda_4dE\$B]$$

Substituting Equations (20), (21), and (22) into the utility function, Equation (16), results in:

$$(23) \quad dU = \frac{\partial U}{\partial S}[gdG + pdL - tdSD - cdCD - fdF - kdB - bdE\$B] + \frac{\partial U}{\partial S}[w_2dG + w_3dL - w_6(1-r)dDD - w_5(1-s)dSD - w_4(1-s)dCD - (1-e)dE\$B - edE\$B_b - dB - dF] + \frac{\partial U}{\partial A} \frac{1}{\sigma}[dG + \lambda_5dL - \lambda_1dCD - \lambda_2dF - \lambda_3dB - \lambda_4dE\$B]$$

Factoring Equation (22) yields the total derivative of the utility function in the following form:

$$(24) \quad dU = dG[\frac{\partial U}{\partial \pi}g + \frac{\partial U}{\partial S}w_2 + \frac{\partial U}{\partial A} \frac{1}{\sigma}] + dL[\frac{\partial U}{\partial \pi}p + \frac{\partial U}{\partial S}w_3 + \frac{\partial U}{\partial A} \frac{1}{\sigma}\lambda_5] - dSD[\frac{\partial U}{\partial \pi}t + \frac{\partial U}{\partial S}w_5(1-s)] - dCD[\frac{\partial U}{\partial \pi}c + \frac{\partial U}{\partial S}w_4(1-s) + \frac{\partial U}{\partial A} \frac{1}{\sigma}\lambda_1] - dDD[\frac{\partial U}{\partial S}w_6(1-r)] - dE\$B[\frac{\partial U}{\partial \pi}b + \frac{\partial U}{\partial S}(1-e)]$$

$$\begin{aligned}
& + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_4] - dE\$B \left[\frac{\partial U}{\partial S} e \right] - dF \left[\frac{\partial U}{\partial \pi} f + \frac{\partial U}{\partial S} + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_2 \right] \\
& - dB \left[\frac{\partial U}{\partial \pi} k + \frac{\partial U}{\partial S} + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_3 \right]
\end{aligned}$$

Desired levels of Euro-dollar borrowings, $E\$B^*$, are those levels which yield the banker maximum utility under the constraints imposed by the bank's accounting balance sheet. Thus the necessary (first order) condition for utility maximization under the conditions of the balance sheet identity is that $dU = 0$ for all variations which satisfy

$$\begin{aligned}
(25) \quad dG + dL &= (1-r)dDD + (1-s)dSD + (1-s)dCD \\
&+ (1-e)dE\$B + edE\$B_b + dF + dB
\end{aligned}$$

Solving Equation (25) for $dE\$B$ yields:

$$\begin{aligned}
(26) \quad dE\$B &= \frac{1}{(1-e)} [dG + dL - (1-r)dDD - (1-s)dCD - edE\$B_b \\
&- dF - dB]
\end{aligned}$$

Substituting Equation (26) into Equation (24) imposes the conditions of the balance sheet identity on the model and yields:

$$\begin{aligned}
(27) \quad dU &= dG \left[\frac{\partial U}{\partial \pi} g + \frac{\partial U}{\partial S} w_2 + \frac{\partial U}{\partial A} \frac{1}{\sigma} \right] + dL \left[\frac{\partial U}{\partial \pi} p + \frac{\partial U}{\partial S} w_3 + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_5 \right] \\
&- dSD \left[\frac{\partial U}{\partial \pi} t + \frac{\partial U}{\partial S} w_5 (1-s) \right] - dDD \left[\frac{\partial U}{\partial S} w_6 (1-r) \right] \\
&- dCD \left[\frac{\partial U}{\partial \pi} c + \frac{\partial U}{\partial S} w_4 (1-s) + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_1 \right] - dE\$B_b \left[\frac{\partial U}{\partial S} e \right] \\
&- dF \left[\frac{\partial U}{\partial \pi} f + \frac{\partial U}{\partial S} + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_2 \right] - dB \left[\frac{\partial U}{\partial \pi} k + \frac{\partial U}{\partial S} + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_3 \right] \\
&- \frac{1}{(1-e)} [dG + dL - (1-r)dDD - (1-s)dSD - (1-s)dCD \\
&- dF - dB] \left[\frac{\partial U}{\partial \pi} b + \frac{\partial U}{\partial S} (1-e) + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_4 \right]
\end{aligned}$$

Factoring and simplifying Equation (27) results in:

$$\begin{aligned}
(28) \quad dU = & dG\left[\frac{\partial U}{\partial \pi}\left(g - \frac{b}{(1-e)}\right) + \frac{\partial U}{\partial S}(w_2-1) + \frac{\partial U}{\partial A} \frac{1}{\sigma}\left(1 - \frac{\lambda_4}{(1-e)}\right)\right] \\
& + dL\left[\frac{\partial U}{\partial \pi}\left(p - \frac{b}{(1-e)}\right) + \frac{\partial U}{\partial S}(w_3-1) + \frac{\partial U}{\partial A} \frac{1}{\sigma}\left(\lambda_5 - \frac{\lambda_4}{(1-e)}\right)\right] \\
& - dSD\left[\frac{\partial U}{\partial \pi}\left(t - \frac{(1-s)b}{(1-e)}\right) + \frac{\partial U}{\partial S}(1-s)(w_5+1) - \frac{\partial U}{\partial A} \frac{1}{\sigma} \frac{(1-s)\lambda_4}{(1-e)}\right] \\
& - dDD\left[\frac{\partial U}{\partial S}(1-r)(w_6+1) - \frac{\partial U}{\partial \pi} \frac{b(1-r)}{(1-e)} - \frac{\partial U}{\partial A} \frac{1}{\sigma} \frac{(1-r)\lambda_4}{(1-e)}\right] \\
& - dCD\left[\frac{\partial U}{\partial \pi}\left(c - \frac{b(1-s)}{(1-e)}\right) + \frac{\partial U}{\partial S}(1-s)(w_4+1) + \frac{\partial U}{\partial A} \frac{1}{\sigma}\right. \\
& \quad \left.(\lambda_1 - \frac{(1-s)\lambda_4}{(1-e)})\right] \\
& - dE\$B_b\left[- \frac{\partial U}{\partial \pi} \frac{be}{(1-e)} - \frac{\partial U}{\partial A} \frac{1}{\sigma} \frac{e\lambda_4}{(1-e)}\right] \\
& - dF\left[\frac{\partial U}{\partial \pi}\left(f - \frac{b}{(1-e)}\right) + \frac{\partial U}{\partial A} \frac{1}{\sigma}\left(\lambda_2 - \frac{\lambda_4}{(1-e)}\right)\right] \\
& - dB\left[\frac{\partial U}{\partial \pi}\left(k - \frac{b}{(1-e)}\right) + \frac{\partial U}{\partial A} \frac{1}{\sigma}\left(\lambda_3 - \frac{\lambda_4}{(1-e)}\right)\right]
\end{aligned}$$

Equation (28) is the total derivative of the utility function under the conditions of the balance sheet identity. The first order conditions of utility maximization, or portfolio equilibrium, require that $dU = 0$ for all variations in the independent variables and thus require that

$$(29) \quad \frac{\partial U}{\partial \pi}\left(g - \frac{b}{(1-e)}\right) + \frac{\partial U}{\partial S}(w_2-1) + \frac{\partial U}{\partial A} \frac{1}{\sigma}\left(1 - \frac{\lambda_4}{(1-e)}\right) = 0$$

$$(30) \quad \frac{\partial U}{\partial \pi}\left(p - \frac{b}{(1-e)}\right) + \frac{\partial U}{\partial S}(w_3-1) + \frac{\partial U}{\partial A} \frac{1}{\sigma}\left(\lambda_5 - \frac{\lambda_4}{(1-e)}\right) = 0$$

$$(31) \quad \frac{\partial U}{\partial \pi}\left(t - \frac{(1-s)b}{(1-e)}\right) + \frac{\partial U}{\partial S}(1-s)(w_5+1) - \frac{\partial U}{\partial A} \frac{1}{\sigma} \frac{(1-s)\lambda_4}{(1-e)} = 0$$

$$(32) \quad \frac{\partial U}{\partial \pi} \frac{b(1-r)}{(1-e)} - \frac{\partial U}{\partial S}(1-r)(w_6+1) + \frac{\partial U}{\partial A} \frac{1}{\sigma} \frac{(1-r)\lambda_4}{(1-e)} = 0$$

$$(33) \quad \frac{\partial U}{\partial \pi} \left(c - \frac{b(1-s)}{(1-e)} \right) + \frac{\partial U}{\partial S} (1-s)(w_4+1) + \frac{\partial U}{\partial A} \frac{1}{\sigma} \left(\lambda_1 - \frac{(1-s)\lambda_4}{(1-e)} \right) = 0$$

$$(34) \quad \frac{\partial U}{\partial \pi} \left(f - \frac{b}{(1-e)} \right) + \frac{\partial U}{\partial A} \frac{1}{\sigma} \left(\lambda_2 - \frac{\lambda_4}{(1-e)} \right) = 0$$

$$(35) \quad \frac{\partial U}{\partial \pi} \frac{be}{(1-e)} + \frac{\partial U}{\partial A} \frac{1}{\sigma} \frac{e\lambda_4}{(1-e)} = 0$$

and that

$$(36) \quad \frac{\partial U}{\partial \pi} \left(k - \frac{b}{(1-e)} \right) + \frac{\partial U}{\partial S^2} + \frac{\partial U}{\partial A} \frac{1}{\sigma} \left(\lambda_3 - \frac{\lambda_4}{(1-e)} \right) = 0$$

The above first order conditions are the general equilibrium conditions for a bank's portfolio. The purpose of this paper is to determine the variables which the banker considers in making Euro-dollar borrowings when faced with a need for reserves as a result of increased loan demand, withdrawal of time and savings deposits, or withdrawal of demand deposits under the restriction that his alternative sources of funds are limited to liquidation of government securities, selling certificates of deposit, purchasing Federal Funds, borrowing from the Federal Reserve, and borrowing Euro-dollars.

When a banker is in need of reserves due to a demand deposit withdrawal he must choose among the combinations of sources of funds which are available to him. It is the purpose of this paper to derive the variables which the banker considers in determining his Euro-dollar borrowings. This may be done by deriving the equilibrium conditions implied by the model when the banker chooses among combinations of Euro-dollar borrowings and other available sources of funds. These conditions are derived for the choices of Euro-dollar borrowings and liquidation of government securities, borrowing Euro-dollars and

selling certificates of deposit, Euro-dollar borrowings and purchases of Federal Funds, and borrowing Euro-dollars and borrowing from the Federal Reserve.

If the banker experiences demand deposit withdrawals and uses Euro-dollar borrowings and government securities sales to regain portfolio equilibrium, the balance sheet identity (25) requires that $(1-e)dE\$B - dG = - (1-r)dDD$. This returns him to portfolio equilibrium with zero excess reserves.

By using the total derivative of the utility function (24) and the necessary conditions of utility maximization a relationship among the variables can be derived under the assumption that Euro-dollar borrowings and government security liquidation are the only available sources of funds.

The total derivative of the utility function may be expressed as:

$$(37) \quad dU = dG \left[\frac{\partial U}{\partial \pi} g + \frac{\partial U}{\partial S} w_2 + \frac{\partial U}{\partial A} \frac{1}{\sigma} \right] - dE\$B \left[\frac{\partial U}{\partial \pi} b + \frac{\partial U}{\partial S} (1-e) \right. \\ \left. + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_4 \right] - dDD \left[\frac{\partial U}{\partial S} w_6 (1-r) \right]$$

and since $(1-e)dE\$B - dG = - (1-r)dDD$ or $dDD = - \frac{(1-e)dE\$B - dG}{(1-r)}$:

$$(38) \quad dU = dG \left[\frac{\partial U}{\partial \pi} g + \frac{\partial U}{\partial S} w_2 + \frac{\partial U}{\partial A} \frac{1}{\sigma} \right] - dE\$B \left[\frac{\partial U}{\partial \pi} b + \frac{\partial U}{\partial S} (1-e) \right. \\ \left. + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_4 \right] + [(1-e)dE\$B - dG] \left[\frac{\partial U}{\partial S} w_6 \right]$$

Equation 38 may be reduced to:

$$(39) \quad dU = dG \left[\frac{\partial U}{\partial \pi} g + \frac{\partial U}{\partial S} (w_2 - w_6) + \frac{\partial U}{\partial A} \frac{1}{\sigma} \right] - dE\$B \left[\frac{\partial U}{\partial \pi} b \right]$$

$$+ \frac{\partial U}{\partial S}(1-e)(1-w_6) + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_4]$$

The first order conditions require that

$$(40) \quad \frac{\partial U}{\partial \pi} g + \frac{\partial U}{\partial S}(w_2 - w_6) + \frac{\partial U}{\partial A} \frac{1}{\sigma} = 0$$

$$(41) \quad \frac{\partial U}{\partial \pi} b + \frac{\partial U}{\partial S}(1-e)(1-w_6) + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_4 = 0$$

so that

$$(42) \quad \frac{\partial U}{\partial \pi} g + \frac{\partial U}{\partial S}(w_2 - w_6) + \frac{\partial U}{\partial A} \frac{1}{\sigma} = \frac{\partial U}{\partial \pi} b + \frac{\partial U}{\partial S}(1-e)(1-w_6) + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_4$$

which implies that

$$(43) \quad \frac{\partial U}{\partial \pi}(g-b) + \frac{\partial U}{\partial S}[(w_2-1) + e(1-w_6)] + \frac{\partial U}{\partial A} \frac{1}{\sigma}(1-\lambda_4) = 0$$

Under the assumption that Euro-dollar borrowings and sales of certificates of deposit are the only available sources of funds by which a banker may adjust to a demand deposit withdrawal he must make the adjustment such that $(1-e)dE\$B + (1-s)dCD = - (1-r)dDD$.

The total derivative of the utility function (24) now becomes:

$$(44) \quad dU = - dCD \left[\frac{\partial U}{\partial \pi} c + \frac{\partial U}{\partial S} w_4(1-s) + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_1 \right] \\ - dE\$B \left[\frac{\partial U}{\partial \pi} b + \frac{\partial U}{\partial S}(1-e) + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_4 \right] - dDD \left[\frac{\partial U}{\partial S} w_6(1-r) \right]$$

Given that $(1-e)dE\$B + (1-s)dCD = - (1-r)dDD$, Equation (44) now becomes:

$$(45) \quad dU = - dCD \left[\frac{\partial U}{\partial \pi} c + \frac{\partial U}{\partial S} w_4(1-s) + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_1 \right] \\ - dE\$B \left[\frac{\partial U}{\partial \pi} b + \frac{\partial U}{\partial S}(1-e) + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_4 \right] \\ + [(1-e)dE\$B + (1-s)dCD] \left[\frac{\partial U}{\partial S} w_6 \right].$$

Equation (45) may be reduced to:

$$(46) \quad dU = - dCD \left[\frac{\partial U}{\partial \pi} c + \frac{\partial U}{\partial S} (1-s) (w_4 - w_6) + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_1 \right] \\ - dE\$B \left[\frac{\partial U}{\partial \pi} b + \frac{\partial U}{\partial S} (1-e) (1-w_6) + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_4 \right]$$

The first order conditions are:

$$(47) \quad \frac{\partial U}{\partial \pi} c + \frac{\partial U}{\partial S} (1-s) (w_4 - w_6) + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_1 = 0$$

$$(48) \quad \frac{\partial U}{\partial \pi} b + \frac{\partial U}{\partial S} (1-e) (1-w_6) + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_4 = 0$$

Equations (47) and (48) make it possible to write

$$(49) \quad \frac{\partial U}{\partial \pi} c + \frac{\partial U}{\partial S} (1-s) (w_4 - w_6) + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_1 \\ = \frac{\partial U}{\partial \pi} b + \frac{\partial U}{\partial S} (1-e) (1-w_6) + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_4$$

which may be expressed as

$$(50) \quad \frac{\partial U}{\partial \pi} (c-b) + \frac{\partial U}{\partial S} [(w_4 - 1) + e(1-w_6) + s(w_6 - w_4)] \\ + \frac{\partial U}{\partial A} \frac{1}{\sigma} (\lambda_1 - \lambda_4) = 0$$

If the banker is allowed to choose only between Federal Reserve borrowings and Euro-dollar borrowings when adjusting to demand deposit withdrawals he must make the portfolio adjustment so that $(1-e)dE\$B + dB = - (1-r)dDD$.

In this case the total derivative of the utility function is expressed as:

$$(51) \quad dU = - dB \left[\frac{\partial U}{\partial \pi} k + \frac{\partial U}{\partial S} + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_3 \right] - dE\$B \left[\frac{\partial U}{\partial \pi} b + \frac{\partial U}{\partial S} (1-e) \right. \\ \left. + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_4 \right] - dDD \left[\frac{\partial U}{\partial S} w_6 (1-r) \right].$$

Substituting $(1-e)dE\$B + dB = - (1-r)dDD$ into Equation (51) yields

$$(52) \quad dU = - dB \left[\frac{\partial U}{\partial \pi} k + \frac{\partial U}{\partial S} + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_3 \right] - dE\$B \left[\frac{\partial U}{\partial \pi} b + \frac{\partial U}{\partial S} (1-e) \right. \\ \left. + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_4 \right] + [(1-e)dE\$B + dB] \left[\frac{\partial U}{\partial S} w_6 \right].$$

Equation (52) is reduced to:

$$(53) \quad dU = - dB \left[\frac{\partial U}{\partial \pi} k + \frac{\partial U}{\partial S} (1-w_6) + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_3 \right] - dE\$B \left[\frac{\partial U}{\partial \pi} b \right. \\ \left. + \frac{\partial U}{\partial S} (1-e) (1-w_6) + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_4 \right]$$

The first order conditions are:

$$(54) \quad \frac{\partial U}{\partial \pi} k + \frac{\partial U}{\partial S} (1-w_6) + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_3 = 0$$

$$(55) \quad \frac{\partial U}{\partial \pi} b + \frac{\partial U}{\partial S} (1-e) (1-w_6) + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_4 = 0$$

which may be written as:

$$(56) \quad \frac{\partial U}{\partial \pi} k + \frac{\partial U}{\partial S} (1-w_6) + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_3 = \frac{\partial U}{\partial \pi} b + \frac{\partial U}{\partial S} (1-e) (1-w_6) + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_4$$

Equation (56) may be formulated as:

$$(57) \quad \frac{\partial U}{\partial \pi} (k-b) + \frac{\partial U}{\partial S} [e(1-w_6)] + \frac{\partial U}{\partial A} \frac{1}{\sigma} (\lambda_3 - \lambda_4) = 0$$

If Euro-dollar borrowings and purchases of Federal Funds are the only sources of funds available to the banker, he must adjust to demand deposit withdrawals so that $(1-e)dE\$B + dF = - (1-r)dDD$.

Under these conditions the total derivative of the utility function is:

$$(58) \quad dU = - dF \left[\frac{\partial U}{\partial \pi} f + \frac{\partial U}{\partial S} + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_2 \right] - dE\$B \left[\frac{\partial U}{\partial \pi} b + \frac{\partial U}{\partial S} (1-e) \right. \\ \left. + \frac{\partial U}{\partial A} \frac{1}{\sigma} \lambda_4 \right] - dDD \left[\frac{\partial U}{\partial S} w_6 (1-r) \right]$$

Equation (59) is derived by substituting $-\frac{(1-e)dE\$B + dF}{(1-r)} = dDD$ into Equation (58) and simplifying:

$$(59) \quad dU = -dF\left[\frac{\partial U}{\partial \pi}f + \frac{\partial U}{\partial S}(1-w_6) + \frac{\partial U}{\partial A}\frac{1}{\sigma}\lambda_2\right] \\ - dE\$B\left[\frac{\partial U}{\partial \pi}b + \frac{\partial U}{\partial S}(1-e)(1-w_6) + \frac{\partial U}{\partial A}\frac{1}{\sigma}\lambda_4\right]$$

The first order conditions are:

$$(60) \quad \frac{\partial U}{\partial \pi}f + \frac{\partial U}{\partial S}(1-w_6) + \frac{\partial U}{\partial A}\frac{1}{\sigma}\lambda_2 = 0$$

$$(61) \quad \frac{\partial U}{\partial \pi}b + \frac{\partial U}{\partial S}[(1-e)(1-w_6)] + \frac{\partial U}{\partial A}\frac{1}{\sigma}\lambda_4 = 0$$

which may be expressed as:

$$(62) \quad \frac{\partial U}{\partial \pi}(f-b) + \frac{\partial U}{\partial S}[e(1-w_6)] + \frac{\partial U}{\partial A}\frac{1}{\sigma}(\lambda_2-\lambda_4) = 0$$

Equations (43), (50), (57), and (62) give the variables which the banker must consider in determining his behavior as a Euro-dollar borrower when faced with demand deposit withdrawals. He is viewed as choosing among combinations of Euro-dollar borrowings, Federal Funds purchases, borrowings from the Federal Reserve, certificate of deposit sales, and Government Securities sales as sources of funds.

The same technique is used to determine those variables which are of interest to the banker in formulating his behavior as a Euro-dollar borrower when experiencing withdrawals of time and savings deposits.

When the banker chooses a combination of government securities liquidation and Euro-dollar borrowings as sources of funds he must choose quantities which satisfy $(1-e)dE\$B - dG = - (1-s)dSD$.

By substitution and simplification the first order conditions, under the constraints of the balance sheet identity, are derived to be:

$$(63) \quad \frac{\partial U}{\partial \pi} [g - b - \frac{et}{(1-s)}] + \frac{\partial U}{\partial S} [(w_2-1) + e(1-w_5)] + \frac{\partial U}{\partial A} \frac{1}{\sigma} (1-\lambda_4) = 0$$

If the banker chooses between Euro-dollars and certificates of deposit as alternative sources of funds, the balance sheet identity requires that $(1-e)dE\$B + (1-s)dCD = - (1-s)dSD$.

The first order conditions are

$$(64) \quad \frac{\partial U}{\partial \pi} [c - b - \frac{t(e-s)}{(1-s)}] + \frac{\partial U}{\partial S} [(w_4-1) + e(1-w_5) + s(w_5-w_4)] + \frac{\partial U}{\partial A} \frac{1}{\sigma} (\lambda_1-\lambda_4) = 0$$

In choosing between Euro-dollar borrowings and borrowings from the Federal Reserve the banker's balance sheet identity requires that $(1-e)dE\$B + dB = - (1-s)dSD$.

With this constraint the first order conditions may be expressed as:

$$(65) \quad \frac{\partial U}{\partial \pi} [k - b - \frac{et}{(1-s)}] + \frac{\partial U}{\partial S} [e(1-w_5)] + \frac{\partial U}{\partial A} \frac{1}{\sigma} (\lambda_4-\lambda_3) = 0$$

If the banker responds to time and savings deposit withdrawals by choosing between Euro-dollar borrowings and Federal Funds as sources of funds the balance sheet identity requires that $(1-e)dE\$B + dF = - (1-s)dSD$.

The first order conditions in this case reduce to:

$$(66) \quad \frac{\partial U}{\partial \pi} [f - b - \frac{et}{(1-s)}] + \frac{\partial U}{\partial S} [e(1-w_5)] + \frac{\partial U}{\partial A} \frac{1}{\sigma} (\lambda_4-\lambda_2) = 0$$

Equations (63), (64), (65), and (66) indicate the variables which the banker considers in re-equilibrating his portfolio when it has been shocked by a reduction in time and savings deposits.

The variables involved in the banker's decisions regarding his behavior as a Euro-dollar borrower will now be derived under the assumption that his need for reserves is a result of increased loan demand. The technique is the same as that used in Equations (37) through (66).

If the banker chooses to make the necessary portfolio adjustment by borrowing Euro-dollars and liquidating government securities the constraint implied by his balance sheet identity is that

$$(1-e)dE\$B - dG = dL.$$

The first order conditions derived from Equation (23) may be expressed as:

$$(67) \quad \frac{\partial U}{\partial \pi}[g-b-pe] + \frac{\partial U}{\partial S}[(w_1-1) + e(1-w_3)] + \frac{\partial U}{\partial A} \frac{1}{\sigma}(1-\lambda_4-\lambda_5 e) = 0$$

The balance sheet identity constraint which applies when the banker uses Euro-dollar borrowings and certificate of deposit sales as the source of funds is $(1-e)dE\$B + (1-s)dCD = dL$.

In this case the first order conditions are:

$$(68) \quad \frac{\partial U}{\partial \pi}[c-b-p(e-s)] + \frac{\partial U}{\partial S}(w_4-1) + s(w_3-w_4) + e(1-w_3) \\ + \frac{\partial U}{\partial A} \frac{1}{\sigma}[(\lambda_1-\lambda_4) + \lambda_5(s-e)] = 0$$

If the banker chooses to adjust his portfolio through Euro-dollar borrowings and borrowings from the Federal Reserve the balance

sheet identity constraint under which he must operate is $(1-e)dE\$B + dB = dL$.

From Equation (23) and the balance sheet constraint, the first order conditions result in:

$$(69) \quad \frac{\partial U}{\partial \pi}[k-b-pe] + \frac{\partial U}{\partial S}[e(1-w_3)] + \frac{\partial U}{\partial A} \frac{1}{\sigma}(\lambda_4 - \lambda_3 + \lambda_5 e) = 0$$

When the banker adjusts his portfolio by borrowing Euro-dollars and purchasing Federal Funds his balance sheet identity requires that $(1-e)dE\$B + dF = dL$.

The first order conditions in this case are expressed as:

$$(70) \quad \frac{\partial U}{\partial \pi}[f-b-pe] + \frac{\partial U}{\partial S}[e(1-w_3)] + \frac{\partial U}{\partial A} \frac{1}{\sigma}(\lambda_4 - \lambda_2 + \lambda_5 e) = 0$$

The variables with which the banker must be concerned when determining his desired level of Euro-dollar borrowings are derived in Equations (43), (50), (57), (62), (63), (64), (65), (66), (67), (68), (69), and (70). The variables are e , s , $(g-b)$, $(c-b)$, $(k-b)$, $(f-b)$, $[g - b - \frac{et}{(1-s)}]$, $[c - b - \frac{t(e-s)}{(1-s)}]$, $[k - b - \frac{et}{(1-s)}]$, $[f - b - \frac{et}{(1-s)}]$, $[g-b-pe]$, $[c-b-p(e-s)]$, $[k-b-pe]$, $[f-b-pe]$, $\frac{\partial U}{\partial \pi}$, $\frac{\partial U}{\partial S}$, $\frac{\partial U}{\partial A}$.

These variables encompass the situation in which the banker needs reserves due to demand deposit withdrawals, time and savings deposit withdrawals, and increased loan demand when he chooses to adjust his portfolio with some combination of Euro-dollar borrowings, Government Security liquidation, certificate of deposit sales, borrowings from the Federal Reserve, and purchases of Federal Funds.

Aigner and Bryan's Model of Short-Run Bank Behavior⁶

The bank behavior model presented by Aigner and Bryan is of particular interest due to its similarity to the model developed in this thesis. The two models are similar in that both use a utility maximization assumption with a balance sheet identity constraint. The models differ in that Aigner and Bryan specify an additive utility function while the form of the utility function used in the model of this thesis remains unspecified. The arguments subsumed by the utility function presented by Bryan and Aigner are not explicitly defined while those of the utility function used in this thesis are.

The Balance Sheet Identity

Aigner and Bryan's basic balance sheet identity is:

$$\begin{aligned} (71) \quad & x_1 + [-y_1] + [-y_2] + x_2 + x_3 + [-y_3] \\ & = y_4 + y_5 + [-x_4] + [-x_5] + [-x_6] + y_6 \end{aligned}$$

where:

- x_1 = excess reserves,
- $-y_1$ = pledged or collateralized investments,
- x_2 = total investments less $[-y_1]$ or "other investments,"
- x_3 = loans to commercial banks,
- $-y_3$ = other loans,
- y_4 = demand deposits,
- y_5 = savings deposits,

⁶Aigner and Bryan, "Short Run Bank Behavior."

$-x_4$ = CDs,

$-x_5$ = borrowings from the Federal Reserve,

$-x_6$ = borrowings from commercial banks,

y_6 = capital accounts.

Variables x_1 through x_6 are viewed as short-run control variables while variables y_1 through y_6 are viewed as being uncontrollable in the short run. The balance sheet identity is rewritten as

$$(72) \quad \sum_{i=1}^6 x_i = \sum_{i=1}^6 y_i .$$

Specifying that $\sum_{i=1}^6 y_i = z$ yields the form of balance sheet

identity used in the model (i.e., $\sum_{i=1}^6 x_i[t] = z[t]$).

The Utility Function

Aigner and Bryan argue that a bank attempts to adjust its portfolio in a manner which maximizes its returns from its short-run adjustment position. The utility derived from an asset (or disutility derived from a liability) is viewed as having two components, the nominal rate of return and a subjective component. The nominal rate of return is the market yield while the subjective returns (or costs) reflect expected future costs or returns. Thus the subjective component subsumes Federal Reserve harassment, liquidity concerns based on the uncertainty of future deposit changes and loan demands, and risk over the portfolio adjustment.

Total returns are specified as:

$$(73) \quad R(t) = \sum_{i=1}^6 \int_0^{x_i} [f_t(u_i) + r_i(t)] du_i$$

where:

$R(t)$ = total returns,

$f_t(u_i)$ = the subjective return (or cost) from the i th controllable variable,

$r_i(t)$ = the nominal return (or cost) from the i th controllable variable.

The Lagrangian equation to be maximized is

$$(74) \quad R'(t) = R(t) + \lambda \left[\sum_{i=1}^6 x_i(t) - z(t) \right],$$

and the first order conditions are

$$(75) \quad f_t(x_i) + r_i(t) + \lambda = 0$$

$$(76) \quad \sum_{i=1}^6 x_i(t) - z(t) = 0$$

Since utility functions are not directly observable functional forms, $f_t(x_i)$ cannot be specified and optimal levels for $[x_i(t)]$ cannot be explicitly derived. Aigner and Bryan accomplish a qualitative analysis using the second order conditions under the assumption of diminishing marginal utility. The qualitative analysis concludes that optimal levels of controllable variables increase as their returns increase and decrease as the returns on substitutes increase.

An Evaluation of the Theoretical Model

By specifying an additive utility function, Aigner and Bryan

fail to recognize the possibility that the marginal utilities of the control variable may not be independent of one another. That is $f_t(x_1)$ may be a function of x_2 through x_6 . Using the summation of the nominal rates plus the subjective rates for each variable as a measure of the total utility received from a given portfolio does not allow for the trade off between total nominal returns and the total effect on utility of the portfolios liquidity characteristics. The model presented in this thesis avoids this unrealistic analytical method.

The Empirical Format

Bryan and Aigner direct their empirical work toward the establishment of subjective return schedules (the f_t 's) for the control variables (the x_i 's). They argue that the equilibrating rate of return is functionally related to the level of the sum of the uncontrollable variables ($z[t]$). The composition of $z(t)$ is not considered as a relevant variable.

Bryan and Aigner test the hypothesis that there is a subjective rate of return affecting bank adjustment decisions using a time series of particular control variables ($x_i[t]$) and a time series of $z(t)$. The series of $z(t)$ is grouped into a set of r contiguous and exhaustive classifications. The model used to posit the proposition that the relationship between $x_i(t)$ and $z(t)$ varies over the scale of $z(t)$ is

$$(77) \quad x_i(t) = \beta_0 + \beta_1 x_i(t) + \dots + \beta_r w_r(t)$$

or

$$x_i(t) = \beta_0 + \sum_{j=1}^r \beta_j w_j(t)$$

where:

$$w_j(t) = z(t) - z_j(t) \text{ if } z_j(t) \leq z(t) \leq z_{j+1}(t)$$

and zero otherwise.

$z_j(t)$ is the lower boundary of the j th category of $z(t)$ so that $w_j(t) = z(t) - z_j(t)$ if and only if $z(t)$ lies in the j th category.

If the nominal rate of return on the controllable variable is the parameter which dominates adjustment decisions, one would expect β_1 through β_r of Equation (7) to be equal to (not significantly different from) one another. Significant differences between the regression coefficients of Equation (7) would support the hypothesis that adjustments in the controllable variables depend on subjective rates of return which are related to the level of $z(t)$.

Equation (77) is empirically tested in a modified form. The nominal rates of return on the x_i 's are included as independent variables in order to capture the shifting of $f_t(x_i)$ over time. A proxy for anticipated deposit movements (A) is also included as a shift variable. The final equation is:

$$(78) \quad x_i(t) = \beta_{0i} + \sum_{j=1}^r \beta_{jk} w_j(t) + \beta_{r+1,i} r_s(t) + \beta_{r+2,i} r_f(t) \\ + \beta_{r+3,i} r_j(t) + \beta_{r+4,i} A(t) + e_i(t)$$

where

r_s = yield on three-month Treasury bills,

r_f = yield on Federal Funds,

r_d = Federal Reserve discount rate.

The Empirical Results

Although Euro-dollar borrowings are not included as a control variable in the model presented by Bryan and Aigner, the empirical results are presented to complete the presentation of their work.

Bryan and Aigner use weekly observations of the balance sheet items from a sample of one bank. The regression coefficients, are estimated with the equations corrected for first order autocorrelation. The reported R^2 's are from equations not corrected for autocorrelation and the Durbin-Watson statistic is not reported.

The $z(t)$ series is divided into six contiguous and exhaustive categories. A test of significant differences among the regression coefficients of these six categories is not reported. The dependent variables $[x_i(t)]$ used to test the final empirical equation (78) are excess reserves, investments, loans to banks, borrowings from Federal Reserve, and Federal Funds borrowings.

$$\begin{aligned}
 (79) \quad \text{Excess reserves} = & 675.3 + 74.0 r_g - 9.5 r_d - 35.2 r_f \\
 & (2.78) \quad (.30) \quad (1.55) \\
 & - 183.0 A - .21 w_1 - .19 w_2 - .18 w_3 \\
 & (1.06) (2.33) \quad (2.49) \quad (2.49) \\
 & - .16 w_4 - .15 w_5 - .18 w_6 \\
 & (2.78) \quad (2.78) \quad (3.14) \\
 R^2 = & .09
 \end{aligned}$$

$$(80) \text{ Investments} = 797.7 + 137.5 r_s - 341.3 r_d - 31.8 r_f$$

(3.36) (6.73) (1.63)

$$+ 1,376.3 A - .11 w_1 - .04 w_2 + .03 w_3$$

(4.26) (1.38) (.65) (.52)

$$+ .09 w_4 + .12 w_5 + .20 w_6$$

(1.95) (2.85) (2.59)

$$R^2 = .73$$

$$(81) \text{ Loans to banks} = -1,149.0 - 209.2 r_s + 395.8 r_d + 59.6 r_f$$

(4.91) (7.71) (1.94)

$$- 1,368.1 A + .92 w_1 + .87 w_2 + .84 w_3$$

(4.67) (6.75) (7.89) (8.86)

$$+ .80 w_4 + .78 w_5 + .77 w_6$$

(9.79) (10.59) (8.59)

$$R^2 = .72$$

$$(82) \text{ Borrowing from Fed} = 158.1 + 13.6 r_s - 57.1 r_d + 15.5 r_f$$

(1.39) (4.87) (1.98)

$$+ 107.6 A - .04 w_1 - .06 w_2 - .05 w_3$$

(1.65) (1.11) (2.18) (2.25)

$$- .05 w_4 - .05 w_5 - .04 w_6$$

(2.47) (2.49) (1.91)

$$R^2 = .20$$

$$(83) \text{ Fed Funds borrowing} = 196.7 + 30.8 r_s + 14.2 r_d - 7.2 r_f$$

(1.90) (.73) (.60)

$$- 231.6 A - .06 w_1 - .04 w_2 - .04 w_3$$

(2.10) (1.19) (.96) (1.11)

$$- .03 w_4 - .04 w_5 - .04 w_6$$

(.97) (1.26) (1.06)

$$R^2 = .08$$

In the excess reserves equation all of the scale variables (w_1 through w_6) are significant. In the Federal Funds borrowings equation none of these variables are significant. There are 18

significant scale variables in the five equations and 15 insignificant ones. Significance of the scale variables indicates that the optimal levels of the control variables are a function of the level of the summation of the uncontrolled variables. Even if all of the scale variables were significant, more information would be needed in order to accept or reject Bryan and Aigner's formulation of the subjective returns construct.

Bryan and Aigner state that "on a priori grounds, if the subjective returns construct is credible, we would expect $\beta_1 > \dots > \beta_r$ in any of the above models ...," where β_1 through β_r are the coefficients of the scale variables. The indicated joint F test for significant differences among a subset of the regression coefficients is not presented, and the necessary statistics for performing this test are not reported.

CHAPTER III

THE ECONOMETRIC MODEL

Black's Econometric Study

Stanley W. Black has published an econometric study of Euro-dollar borrowings by New York banks¹ in which reduced form equations are estimated from weekly data covering the period 1966-1968.

Black states that "the literature on bank-liquidity adjustments makes it clear that the main instruments used in the week-to-week management of liquidity positions of money-market banks are short-term U. S. Government obligations, borrowings of Federal Funds from other banks, borrowings from the Federal Reserve, and loans to dealers. More recently, certificates of deposits (CDs) and Euro-dollar borrowings have been used both in liquidity management and as a source of more permanent lendable funds." Black's demand equation for Euro-dollar borrowings is

$$(84) \quad E\$ = a + bCD + cRE + dRFF + eRTB$$

where:

$E\$$ = Euro-dollar borrowings,

CD = the quantity of CDs outstanding,

RE = the three-month rate on Euro-dollars,

¹Stanley W. Black. "An Econometric Study of Euro-Dollar Borrowings by New York Banks and the Rate of Interest on Euro-Dollars," Journal of Finance, Volume XXVI (March, 1971), 83-88.

RFF = the Federal Funds rate,

RTB = the rate on Treasury bills.

and the expected signs on the coefficients are:

$$b < 0, c < 0, d > 0, e > 0$$

The level of CDs is entered with a negative sign as a proxy for the effects of Regulation Q on Euro-dollar borrowings. Black argues that "when the interest rate on CDs hits the Regulation Q ceiling, supply side effects take over to reduce CD money available." It follows that the level of CDs should be used as a proxy only during periods when offer rates on CDs reach Regulation Q ceilings (or when secondary market CD rates exceed Regulation Q ceilings) rather than being used throughout the sample period.

Black's supply equation results from an assumption of interest elastic financial flows and a view of the Euro-dollar as a vehicle of exchange rate speculation. He also includes a proxy for the effects of the U. S. Balance of Payments Voluntary Foreign Credit Restriction Program. The supply equation is:

$$(85) \quad ES = f + gRE + hRTB + iFL + kBPR + lUKBR$$

$$g > 0, h < 0, j < 0, k?, l < 0$$

where

FL = the discount on the forward pound sterling vis-a-vis the U. S. dollar,

BPR = the proxy for the effect of the U. S. Balance of Payments Voluntary Foreign Credit Restriction Program. "BPR = $\frac{100}{100-k}$, where k is the percentage above the 1964 base that banks were allowed to extend loans under the program,"

UKBR = the U. K. Bank rate.

The reduced form equations which Black derives from his supply and demand equations are

$$(86) \quad E\$ = a_1 + a_2 CD + a_3 RFF + a_4 RTB + a_5 FL + a_6 BPR + a_7 UKBR$$

$$a_2 < 0, a_3 > 0, a_4?, a_5 < 0, a_6?, a_7 < 0$$

$$(87) \quad RE = b_1 + b_2 CD + b_3 RFF + b_4 RTB + b_5 FL + b_6 BPR + b_7 UKBR$$

$$b_2 < 0, b_3 > 0, b_4 > 0, b_5 > 0, b_6?, b_7 > 0$$

Blacks' estimates of the reduced form equations yield

$$(88) \quad E\$ = -1413 - .09 CD + 131 RFF + 542 RTB - 57 FL$$

(2.2) (2.7) (7.7) (1.8)

$$- 91 FL_{t-1} + 26 T$$

(3.0) (44.3)

$$R^2 = .96, se = 261, d = .66$$

and

$$(89) \quad \Delta RE = .200 + .168 RTB + .402 \Delta RTB + .022 FL + .044 \Delta FL$$

(2.6) (2.8) (1.6) (2.2)

$$+ .075 RFF - .0058 BPR - .0002 \Delta CD_{t-1} + .415 \Delta UKDR$$

(2.2) (2.1) (2.1) (5.2)

$$- .216 RE_{t-1}$$

(4.6)

$$R^2 = .40, se = .168, d = 1.65$$

Equation (89) is considerably different from Equation (87).

A Koyck lag has been used and several independent variables have been entered as first differences and with lags for unspecified reasons. The tested Equation (89) seems to have evolved from the theoretical Equation (87) in some ad hoc and unexplained fashion.

By setting all of the change variables equal to zero and algebraically solving for RE, Black derives the equilibrium form of Equation (87).

$$(90) \quad RE = .93 + .77 RTB + .35 RFF + .10 FL - .027 BPR$$

Black uses Equations (88) and (90) to derive the coefficients of the structural Equations (84 and 85). In order to solve for the coefficients of the structural equations he arbitrarily eliminates the time trend in Equations (88) and (90) and adds the coefficients of FL and FL_{t-1} in Equation (88). The derived equations are

$$\text{DEMAND: } E\$ = .446 CD - 1480 RE + 650 RFF + 1681 RTB$$

$$\text{SUPPLY: } E\$ = 374 RE + 254 RTB - 185 FL + 50 BPR$$

Evaluation of Black's Study

Black has chosen to use interest rate levels as the independent variables in his structural equations without theoretically deriving those variables. The theoretical model of this thesis yields interest rate differentials as independent variables. Using interest rate differentials implies that the banker is sensitive to relative costs of adjustment (in particular the cost of adjusting with Euro-dollar borrowings relative to the cost of other adjustment instruments). Black's study views the banker as being sensitive to the absolute cost of each adjustment instrument.

Black uses the traditional indirect least squares technique to derive estimates of the coefficient of his structural equations. This technique requires that the system be exactly identified. Black's structural supply equation contains two endogenous variables and three exogenous variables, his structural demand equation contains two endogenous and four exogenous variables, and the system contains two endogenous and six exogenous variables. There are three variables

in the system which are not in the supply equation and two variables in the system which are not in the demand equation. Both structural equations in the system are overidentified (i.e., $3 > 2-1$ and $2 > 2-1$).

Black's use of indirect least squares estimation for an overidentified structural system is questionable. Black eliminated overidentifying restrictions from his reduced form equations in order to solve for the structural parameters. According to Goldberger "consistent estimates are still obtained, but this procedure is not recommended since it is arbitrary and since discarding information, as usual, results in loss of efficiency."²

The Model to be Tested

Institutional considerations lead to the addition of variables to those derived in Chapter II. The effect which Regulation Q ceilings on CD offer rates (c_0) has on Euro-dollar borrowings was discussed in Chapter I. A proxy for this effect is included in the econometric equation to be tested. The proxy is the difference between secondary market CD rates and the Regulation Q ceiling ($c_s - Q$).

When the secondary CD market rate exceeds Regulation Q ceilings banks are effectively restricted from issuing CDs at the offer rate (c_0) and it is believed that banks rely more heavily on Euro-dollar borrowings for portfolio adjustment purposes at these times.

²Arthur S. Goldberger, Econometric Theory (New York: John Wiley and Sons, Inc., 1964).

It is expected that Euro-dollar borrowings are positively related to $(c_g - Q)$.

Not all of the reserve requirement regulations affecting Euro-dollar borrowings (Regulation D and M) discussed in Chapter I have been incorporated in the theoretical model of Chapter II. In particular the reserve requirement Equation (4) of the theoretical model is developed under the assumption that officer's checks issued in repayment of Euro-dollar borrowings are included in gross demand deposits. This assumption is valid only for the period after July, 1969. To adjust for the bonus received from the clearing process prior to July, 1969, the 90 day Euro-dollar rate (b) and the Euro-dollar call rate (cb) have been adjusted by using the demand deposit reserve requirement ratio. It is specified that prior to July, 1969

$$b = \frac{b'}{1+.11r} \text{ and } cb = \frac{cb'}{1+r}$$

where b' and cb' are the market rates and r is the demand deposit reserve requirement ratio. This adjustment yields the effective rate on the total reserves, including the clearing process bonus, acquired through Euro-dollar borrowings for the pre-July, 1969 period. For the post-July, 1969 period market rates are used.

The level of the reserve requirement ratio on Euro-dollar borrowings (e) is derived in the theoretical model and used in the empirical equation. The effects of the changes in the definition of the reserve free base are represented by dummy variables D_1 and D_2 . The dummy variable D_1 represents the reserve free base definition which was in effect from September, 1969 to January, 1971. The variable

D_2 represents the reserve free base definition which has been in effect since January, 1971.

It is expected that D_1 is positively related to Euro-dollar borrowings by United States banks. The exclusion of some portion of Euro-dollar borrowings from reserve requirements should lead to greater Euro-dollar borrowings than would be the case if all borrowings were subject to reserve requirements. D_2 is also expected to be positively related to Euro-dollar borrowings since the January, 1971 definition of the reserve free base incorporated an effective downward adjustment mechanism which was intended to encourage bankers to borrow quantities of Euro-dollars sufficient to maintain their reserve free bases.

In the interest rate differentials of the theoretical model the 90 day Euro-dollar rate (b) is used in comparisons involving 90 day money market instrument rates (g and c_0). The Euro-dollar call rate (cb) is used in comparisons involving shorter term money market instrument rates (f and k).

A time trend is added to the empirical equation to account for the increase in the number of American banks and foreign branches of American banks involved in the Euro-dollar market which occurred through most of the sample period. The Euro-dollar market was fairly new at the beginning of the sample period (January, 1965) and increased recognition of and familiarity with the market throughout the sample period lends support to the existence of a time trend. The time trend (T) is expected to be positively related to Euro-dollar borrowings.

Aside from institutional considerations the nature of the data leads to the exclusion of some variables derived from the theoretical model. A high degree of multi-collinearity leads to the elimination of $[g - b - \frac{et}{(1-s)}]$, $[g - b - ep]$, $[c_0 - b - \frac{t(e-s)}{(1-s)}]$, $[c_0 - b - p(e-s)]$, $[k - cb - \frac{et}{(1-s)}]$, $[k - cb - ep]$, $[f - cb - ep]$, and $[f - cb - \frac{et}{(1-s)}]$; while $(g - b)$, $(c_0 - b)$, $(k - cb)$ and $(f - cb)$ are included.

Linear regression is used in the empirical estimation and the above revisions yield the following equation for Euro-dollar demand by United States banks:

$$\begin{aligned}
 (91) \quad E\$B = & \alpha_0 + \alpha_1(g - b) + \alpha_2(c_0 - b) + \alpha_3(f - cb) + \alpha_4(k - cb) \\
 & + \alpha_5(c_s - Q) + \alpha_6e + \alpha_7s + \alpha_8D_1 + \alpha_9D_2 \\
 & + \alpha_{10}T + (1 - \lambda)E\$B_{t-1} + u_t \\
 & \alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6, \alpha_7, \alpha_8, \alpha_9, \alpha_{10}, > 0 \quad \alpha_6 < 0
 \end{aligned}$$

In addition to estimating Equation (91), an equation will be tested with the summation of the interest rate differentials substituted for the separately entered interest rate differentials. This is done to eliminate the effects of multi-collinearity among the interest rate differentials.

$$\begin{aligned}
 (92) \quad E\$B = & \alpha'_0 + \alpha'_1X + \alpha'_2(c_s - Q) + \alpha'_3e + \alpha'_4s + \alpha'_5D_1 \\
 & + \alpha'_6D_2 + \alpha'_7T + (1 - \lambda)E\$B_{t-1} + u_t
 \end{aligned}$$

where

$$X = (g - b) + (c_0 - b) + (f - cb) + (k - cb)$$

and

$$\alpha_1', \alpha_2', \alpha_4', \alpha_5', \alpha_6', \alpha_7' > 0 \quad \alpha_3' < 0$$

The coefficients on the interest rate differentials are expected to be positive. An increase in the differentials implies a decrease in the cost of Euro-dollar borrowings relative to the cost of alternative adjustment instruments.

The coefficient on the savings deposit reserve requirement ratio is expected to be positive. An increase in this ratio increases the absolute size of the adjustment required to regain equilibrium following a given change in savings deposits.

The coefficient on the Euro-dollar borrowings reserve requirement ratio is expected to be negative. An increase in this ratio decreases the quantity of excess reserves gained through Euro-dollar borrowings and thus increase the per unit cost of these reserves. An increase in the Euro-dollar borrowings reserve requirement ratio increases the effective cost of using Euro-dollar borrowings as an adjustment mechanism.

CHAPTER IV

THE EMPIRICAL EVIDENCE

The Data

The empirical examination spans the sample period from the four-week period ending January 27, 1965 through the four-week period ending April 28, 1971. This includes almost the entire period of significant Euro-dollar activity by United States banks and encompasses both the 1966 and the 1969 tight money periods.

The data for each variable consist of 82 four-week-averages of weekly-averages of daily observations, except that four-week averages of weekly observations are used when daily observations are not available. Euro-dollar borrowings are denominated in millions of dollars, and all other variables are in percentages. A detailed description of the data and data sources is presented in Appendix A.

In the case of Euro-dollar borrowings, four-week-averages are used because "net liabilities to own foreign branches" is not available. "Gross liabilities to own foreign branches" is used, and it is believed that "due from own foreign branches" (the difference between gross and net liabilities to own foreign branches) is fairly stable over a four-week-averaging period, while it may fluctuate significantly on a daily or weekly-average basis.

The special Euro-dollar certificates issued to foreign branches of United States banks (as described in Chapter I) by the United States Treasury and the Import-Export Bank are added to "gross liabilities to own foreign branches" as a measure of Euro-dollar borrowings. United States banks are allowed to include their foreign branches' holdings of these certificates in calculating the reserve free base for Euro-dollar borrowings. Parent banks are able to reduce their "liabilities to own foreign branches" by the amount of these certificate holdings without eroding their reserve free base. The quantity of these special certificate issues is therefore added to "gross liabilities to own foreign branches" in order to estimate the quantity of Euro-dollar borrowings which would occur if these certificates were not issued.

Individual bank data would be best suited for testing the model of bank behavior developed in Chapter II of this thesis. Aggregate data are used because they are available and individual bank data are not.

The Estimation Procedure

Linear estimation is used throughout the empirical examination. The regression techniques employed are ordinary least squares, two stage least squares, and three stage least squares. The basic problems inherent in the data of this model are simultaneity bias and auto-correlation of the error terms.

First order processes prove to be inadequate in removing auto-correlation in the error terms and two second order processes

are employed. The generalized least squares (G.L.S.) procedure hypothesizes that:

$$\epsilon_t = \rho_1 \epsilon_{t-1} + \rho_2 \epsilon_{t-2} + u_t$$

where:

ϵ = the residuals of the original equations,

ρ_1 = the first order auto-correlation coefficient,

ρ_2 = the second order auto-correlation coefficient,

u = the random error term.

In the generalized least squares procedure ρ_1 and ρ_2 are estimated using ordinary least squares and these estimates are used to transform the data of the original equation.

In addition to the generalized least squares procedure, a scanning procedure is used.¹ In the scanning procedure ρ_1 and ρ_2 are allowed to vary from -1 to 1. That combination of ρ_1 and ρ_2 which minimizes the residual mean squares of the regression equation is chosen as the most efficient combination.

Two and three stage least squares techniques are used to eliminate the effects of the simultaneous determination of Euro-dollar borrowings and Euro-dollar rates. A supply function is specified in order to use these techniques.

In specifying the supply function international financial flows are viewed as being highly interest elastic. The supply of Euro-dollar deposits is specified as a function of covered interest

¹C. Hildreth and Y. Y. Lu, "Demand Relations with Auto-Correlated Disturbances," Michigan State University Technical Bulletin 276, 1960.

arbitrage between United States financial markets and the Euro-dollar market, British financial markets and the Euro-dollar market, and between German financial markets and the Euro-dollar market. The supply equation is

$$(93) \quad E\$S^S = \beta_0 + \beta_1(g-b) + \beta_2(UKt-b) + \beta_3(Gi-B) + \beta_4(c_s-cb) \\ + \beta_5(UKc-cb) + \beta_6(Gc-cb) + \beta_7 T + u_t$$

where

UKt = the United Kingdom 90-day Treasury bill rate plus the percentage premium (+) or discount (-) on the three-month forward pound sterling vis-a-vis the dollar. UKt-b is the difference between the proxy for all United Kingdom 90-day financial market rates and the 90-day Euro-dollar market rate covered for exchange risk from the viewpoint of the British investor.

Gi = the 90-day German interbank loan rate plus the percentage premium or discount on the three-month forward German mark vis-a-vis the dollar. Gi-b is the covered difference between the proxy for all German domestic 90-day financial market rates and the 90-day Euro-dollar market rate.

UKc = the rate on United Kingdom two-day local authority deposits. UKc-cb is the difference between the proxy for all United Kingdom domestic call market rates and the Euro-dollar call market rate.

Gc = the German interbank call money rate. Gc-cb is the difference between the proxy for all German call market rates and the Euro-dollar call market rate.

$E\$S^S$ = the supply of Euro-dollar deposits.

All of the rate differentials of the supply function are expected to be inversely related to the supply of Euro-dollar deposits. Investors are viewed as preferring higher returns to lower returns and an increase in the rate differentials of the supply function

implies a decrease in the Euro-dollar rate relative to alternative rates.

There are four endogenous variables ($E\$B^d$, $E\$S^s$, b , cb) in the simultaneous equation system under consideration. In order to derive reduced form equations for b and cb the demand and supply equations are divided into two call market equations and two 90-day equations.

The call market supply and demand equations are:

$$(94) \quad E\$B_C^d = \alpha_0 + \alpha_1 E + \alpha_2 S + \alpha_3 (c_s - Q) + \alpha_4 (f - cb) + \alpha_5 (k - cb) \\ + \alpha_6 D_1 + \alpha_7 D_2 + \alpha_8 T + u_t$$

and

$$(95) \quad E\$S_C^s = \beta_0 + \beta_1 (c_s - cb) + \beta_2 (Gc - cb) + \beta_3 (UKc - cb) + \beta_4 T + u_t$$

Assuming equilibrium, $E\$B = E\S , the reduced form equation for cb is:

$$(96) \quad cb = \gamma_0 + \gamma_1 c_s + \gamma_2 f + \gamma_3 k + \gamma_4 Gc + \gamma_5 UKc + \gamma_6 Q \\ + \gamma_7 E + \gamma_8 S + \gamma_9 D_1 + \gamma_{10} D_2 + u_t$$

where

$$\gamma_0 = \frac{\alpha_0 - \beta_0}{\alpha_4 + \alpha_5 - \beta_1 - \beta_2 - \beta_3}$$

$$\gamma_5 = \frac{-\beta_3}{\alpha_4 + \alpha_5 - \beta_1 - \beta_2 - \beta_3}$$

$$\gamma_1 = \frac{\alpha_3 - \beta_1}{\alpha_4 + \alpha_5 - \beta_1 - \beta_2 - \beta_3}$$

$$\gamma_6 = \frac{-\alpha_3}{\alpha_4 + \alpha_5 - \beta_1 - \beta_2 - \beta_3}$$

$$\gamma_2 = \frac{\alpha_4}{\alpha_4 + \alpha_5 - \beta_1 - \beta_2 - \beta_3}$$

$$\gamma_7 = \frac{\alpha_1}{\alpha_4 + \alpha_5 - \beta_1 - \beta_2 - \beta_3}$$

$$\gamma_3 = \frac{\alpha_5}{\alpha_4 + \alpha_5 - \beta_1 - \beta_2 - \beta_3}$$

$$\gamma_8 = \frac{\alpha_2}{\alpha_4 + \alpha_5 - \beta_1 - \beta_2 - \beta_3}$$

$$\gamma_4 = \frac{-\beta_2}{\alpha_4 + \alpha_5 - \beta_1 - \beta_2 - \beta_3}$$

$$\gamma_9 = \frac{\alpha_6}{\alpha_4 + \alpha_5 - \beta_1 - \beta_2 - \beta_3}$$

$$\gamma_{10} = \frac{\alpha_7}{\alpha_4 + \alpha_5 - \beta_1 - \beta_2 - \beta_3}$$

The 90-day market supply and demand equations are:

$$(97) \quad E\$B_N^d = \alpha_0' + \alpha_1'E + \alpha_2'S + \alpha_3'(c_g - Q) + \alpha_4'(g - b) + \alpha_5'(c_0 - b) \\ + \alpha_6'D_1 + \alpha_7'D_2 + \alpha_8'T + u_t$$

and

$$(98) \quad E\$S_N^s = \beta_0' + \beta_1'(g - b) + \beta_2'(gi - b) + \beta_3'(UKt - b) + \beta_4'T + u_t$$

The reduced form equation derived from Equations (97) and (98) is:

$$(99) \quad b = \gamma_0' + \gamma_1'g + \gamma_2'c_0 + \gamma_3'Gi + \gamma_4'UKt + \gamma_5'(c_g - Q) \\ + \gamma_6'S + \gamma_7'E + \gamma_8'D_1 + \gamma_9'D_2 + u_t$$

where:

$$\begin{aligned} \gamma_0' &= \frac{\alpha_0' - \beta_0'}{\alpha_4' + \alpha_5' - \beta_1' - \beta_2' - \beta_3'} & \gamma_5' &= \frac{\alpha_3'}{\alpha_4' + \alpha_5' - \beta_1' - \beta_2' - \beta_3'} \\ \gamma_1' &= \frac{\alpha_4' - \beta_1'}{\alpha_4' + \alpha_5' - \beta_1' - \beta_2' - \beta_3'} & \gamma_6' &= \frac{\alpha_2'}{\alpha_4' + \alpha_5' - \beta_1' - \beta_2' - \beta_3'} \\ \gamma_2' &= \frac{\alpha_5'}{\alpha_4' + \alpha_5' - \beta_1' - \beta_2' - \beta_3'} & \gamma_7' &= \frac{\alpha_1'}{\alpha_4' + \alpha_5' - \beta_1' - \beta_2' - \beta_3'} \\ \gamma_3' &= \frac{-\beta_2'}{\alpha_4' + \alpha_5' - \beta_1' - \beta_2' - \beta_3'} & \gamma_8' &= \frac{\alpha_6'}{\alpha_4' + \alpha_5' - \beta_1' - \beta_2' - \beta_3'} \\ \gamma_4' &= \frac{-\beta_3'}{\alpha_4' + \alpha_5' - \beta_1' - \beta_2' - \beta_3'} & \gamma_9' &= \frac{\alpha_7'}{\alpha_4' + \alpha_5' - \beta_1' - \beta_2' - \beta_3'} \end{aligned}$$

Ordinary least squares estimations of the reduced form equations (96 and 99) yield:

$$\hat{cb} = -3.25 + .78c_g + .02f + 1.13k + .20Gc - .26UKc - .29Q \\ + .17E + .28S - 2.52D_1 - 4.15D_2$$

$$\bar{R}^2 = .78 \quad DW(d) = 2.09$$

and

$$\begin{aligned} b = & - .69 + .57g - .21c_0 + .53G1 + .12UKt + .21(c_s - Q) \\ & + .22S - .10E + 1.00E_1 + .96D_2 \\ \bar{R}^2 = & .96 \quad DW(d) = .97 \end{aligned}$$

Two stage least squares estimation of the aggregated supply function (93) yields:

$$\begin{aligned} ESS^s = & - 958.66 - 1,968.52(g-b) - 538.35(UKt-b) - 1,730.79(G1-b) \\ & + 131.13(c_s - cb) - 367.10(UKc-cb) + 276.19(Gc-cb) \\ & + 88.46T + u_t \\ \bar{R}^2 = & .97 \quad DW(T) = .734 \end{aligned}$$

The demand equations will be tested using the stock adjustment formulation (91 and 92) developed in Chapters II and III. These equations will also be tested in a static form, deleting the lagged dependent variable from the set of independent variables. This formulations results from the assumption that 100 percent adjustment can be achieved in a single period, which implies that the coefficient of the lagged dependent variable is zero (or that γ of Equation (1) is one).

Estimation of the Stock Adjustment Equation

Estimation of the stock adjustment form of the demand for Euro-dollar borrowings by United States banks yields adjusted R^2 s in excess of .99. The Durbin-Watson statistics range from 1.572 to 2.027 (indicating that the second order processes are success-

TABLE 4.1^a

Ordinary Least Squares Estimates and Corrections of Auto-Correlation of the Stock Adjustment Equation

Dependent Variable - ESB_t

Equation number and correction procedure	Constant	g-b	c ₀ -b	f-cb	k-cb	X	c _a -Q	e	s	D ₁	D ₂	T	ESB_{t-1}	R ²	\bar{R}^2	ρ_1	ρ_2	D-W
(1)	-195.39 (-.541)	-229.16 (-1.585)	-2.98 (-.025)	91.47 (.740)	-115.59 (-.907)		361.13 (2.508)	-140.00 (-1.817)	16.37 (.197)	693.24 (.849)	1,180.20 (.805)	25.65 (3.472)	.78 (13.614)	.9948	.9940			1.622
(1) G.L.S.	-227.12 (-.653)	-279.71 (-2.089)	.95 (.009)	95.32 (.877)	-91.51 (-.815)		311.96 (2.439)	-123.00 (-1.8021)	-5.64 (-.082)	521.71 (.711)	700.35 (.552)	26.14 (3.686)	.79 (13.811)			.221	-.373	2.027
(1) Scanning	-186.94 (-.634)	-284.39 (-2.177)	4.95 (.047)	90.80 (.853)	-85.71 (-.780)		307.97 (2.460)	-119.33 (1.752)	-9.11 (-.136)	471.27 (.646)	625.12 (.493)	25.69 (3.721)	.80 (14.190)			.200	-.400	2.004
(2)	-15.98 (-.051)					-40.05 (-2.468)	429.69 (4.249)	-124.17 (-1.579)	8.50 (.112)	383.62 (.464)	744.48 (.502)	23.90 (3.520)	.82 (14.738)	.9943	.9937			1.644
(2) G.L.S.	54.82 (.179)					-35.47 (-2.371)	386.73 (3.823)	-101.31 (-1.385)	-15.89 (-.231)	105.44 (.136)	220.77 (.163)	23.34 (3.447)	.84 (14.662)			.209	-.294	1.981
(2) Scanning	55.32 (.199)					-35.93 (-2.405)	383.271 (3.813)	-100.87 (-1.377)	-17.44 (-.257)	94.387 (.1214)	210.627 (.155)	23.30 (3.462)	.84 (14.76)			.200	-.300	1.968

^aNote: R^2 = coefficient of determination.
 \bar{R}^2 = R^2 adjusted for degrees of freedom.
D-W = Durbin-Watson statistic.
"t" values in parenthesis under coefficient estimates.

TABLE 4.2^a

Two Stage Least Squares Estimates and Correction for Auto-Correlation of Stock Adjustment Equation

Dependent Variable - ESB_t

Equation number and correction procedure	Constant	$g-\hat{b}$	$c_0-\hat{b}$	$f-\hat{c}b$	$k-\hat{c}b$	X	c_s-Q	e	s	D_1	D_2	T	ESB_{t-1}	R^2	\bar{R}^2	ρ_1	ρ_2	D-W
(1)	32.42 (.086)	-156.67 (-1.019)	-18.25 (-.145)	114.97 (.820)	-260.87 (-2.021)		315.28 (2.029)	-142.46 (-1.785)	-17.17 (-.203)	539.81 (.635)	1,249.9 (.824)	27.30 (3.549)	.77 (12.464)	.9944	.9936			1.572
(1) G.L.S.	-55.46 (-.155)	-216.69 (-1.491)	-51.34 (-.427)	172.77 (1.357)	-259.85 (-2.231)		209.37 (1.477)	-113.10 (-1.597)	-32.45 (-.438)	315.23 (.410)	603.92 (.459)	28.36 (3.693)	.77 (12.131)			.247	-.325	1.948
(2)	-51.92 (-.165)					-89.03 (-2.144)	371.66 (3.367)	-130.21 (-1.636)	14.90 (.194)	378.27 (.453)	839.45 (.559)	23.51 (3.43)	.80 (13.501)	.9942	.9936			1.582
(2) G.L.S.	-2.69 (-.009)					-99.93 (-2.552)	320.46 (2.987)	-97.77 (-1.361)	-9.606 (-.1379)	-16.93 (-.022)	87.78 (.066)	24.20 (3.509)	.81 (13.123)			.249	-.307	2.017

^aSee note to Table 4.1.

TABLE 4.3

Three Stage Least Squares Estimates of the Stock Adjustment Equation

Dependent Variable - ESB_t

Equation number	Constant	$g-b$	c_0-b	$f-cb$	$k-cb$	X	c_s-Q	e	s	D_1	D_2	T	ESB_{t-1}
(1)	-272.96 (-.767)	-188.97 (-1.295)	-149.72 (-1.300)	91.43 (.7175)	-370.01 (-3.059)		344.99 (2.411)	-194.44 (-2.661)	52.37 (.658)	120.23 (1.534)	1,987.04 (1.427)	40.947 (5.761)	.60 (10.770)
(2)	-390.04 (-1.302)					-161.42 (-4.097)	462.22 (4.461)	-177.62 (-2.412)	96.69 (1.331)	961.55 (1.234)	1,496.37 (1.074)	35.34 (5.543)	.65 (11.866)

ful in correcting for auto-correlation).² The results of the stock adjustment estimations are presented in Tables 4.1, 4.2, and 4.3.

Ordinary least squares estimation of the stock adjustment equation (Table 4.1) yields only three significant³ variables; the proxy for Regulation Q ($c_s - Q$), the time trend (T), and the lagged dependent variable ($E\$B_{t-1}$). Although all of the significant variables and most ($f - cb$, E, S, D_1 , and D_2) of the other variables have coefficients of the anticipated sign, three of the rate differential variables carry negative coefficients, which are inconsistent with the theory of Chapter II. Federal funds constitute the closest substitute for Euro-dollar borrowings, and it is encouraging that the federal funds-Euro-dollar rate differential carries a coefficient of the anticipated sign.

When the ordinary least squares estimation is corrected for auto-correlation, the reserve requirement on savings and time deposits remains insignificant but its coefficient becomes negative (a positive coefficient was anticipated). Correction for auto-correlation yields a significant and negative coefficient on the government securities-Euro-dollar rate differential. Using an index of rate differentials, rather than entering them individually, yields a significant interest rate effect with a negative coefficient.

²It should be noted that the Durbin-Watson statistic is asymptotically biased toward two when used with ordinary least squares estimations which include lagged endogenous variables. Marc Nerlove, and Kenneth F. Wallis, "Use of the Durbin-Watson Statistic in Inappropriate Situations," Econometrica, Volume XXXIV (January, 1966), 235-238.

³All tests of significance are at the .05 level.

The inconsistencies between the theoretically anticipated and empirically estimated coefficients on the government securities--Euro-dollar differential, the CD-Euro-dollar rate differential, and the discount-Euro-dollar rate differential may be the result of the simultaneous determination of Euro-dollar borrowings and Euro-dollar rates. Two and three stage least squares are used to eliminate the effects of simultaneity bias.

The two stage least squares results (Table 4.2) are very similar to those of ordinary least squares estimation. The federal funds-Euro-dollar rate differential remains insignificant and its coefficient maintains the theoretically anticipated sign. Two stage least squares estimation yields one rate differential ($k-cb$) which is significant with a negative coefficient, as did ordinary least squares estimation ($g-b$).

Three stage least squares estimation adds the reserve requirement on Euro-dollar borrowings to the list of significant variables with coefficients of the anticipated sign. The reserve requirement on time and savings deposits remains insignificant but becomes positively signed (as theoretically anticipated). Three of the interest rate differential coefficients are negatively signed; however, two of them are insignificantly different from zero.

The number of periods required for a given proportion of adjustment, and the average lag in adjustment, can be calculated

from the adjustment coefficient ($\gamma = 1 - \text{the coefficient of } E\B_{t-1}).⁴ The three stage least squares estimate of the adjustment coefficient is .40, which implies that four and one-half periods (18 weeks) are required for 90 percent adjustment to be achieved. The implied-average lag in adjustment is one and one-half periods (six weeks).

Estimation of the stock adjustment equation yields a disappointing number of insignificant coefficients. The collinearity between the lagged dependent variable ($E\$B_{t-1}$) and the other independent variables of the stock adjustment model results in a larger variance of the coefficient estimates than would exist if collinearity were not present. This larger variance results in lower levels of significance for the estimated coefficients. Elimination of the lagged dependent variable, or estimation of the static equation, is used to eliminate this collinearity.

If the stock adjustment equation represents the proper specification of the demand for Euro-dollar borrowings by United States banks, then the static form of the equation is misspecified. This misspecification leads to relatively low standard errors associated with biased coefficient estimates.

⁴If p is the number of periods required to obtain k proportion of total adjustment, then $p = \frac{\ln(1-k)}{\ln(1-\gamma)}$ and the average lag in adjustment is equal to $\frac{(1-\gamma)}{\ln(1-\gamma)}$. Kenneth F. Wallis, "Some Recent Developments in Applied Econometrics: Dynamic Models and Simultaneous Equation Systems," Journal of Economic Literature, Volume VII (September, 1969), 771-96.

The three stage least squares estimate of the adjustment coefficient lends credence to the hypothesis of rapid adjustment, and a priori information indicates that bankers adjust their Euro-dollar borrowings very rapidly. The static form of the demand by United States banks for Euro-dollar borrowings equation is estimated with the above mentioned qualifications in mind.

Estimation of the Static Equation

Estimation of the static form of the demand for Euro-dollar borrowings by United States banks yields adjusted R^2 s ranging from .9752 to .9790. The Durbin-Watson statistics range from .824 to 1.866. The results of the estimations of the static equation are presented in Tables 4.4 and 4.5.

Ordinary least squares estimation (corrected for autocorrelation) of the static form of the equation for Euro-dollar demand by United States banks yields significant coefficients with the anticipated signs for the federal funds-Euro-dollar rate differential ($f-cb$), the proxy for the effect of Regulation Q (c_s-Q), the reserve requirement on Euro-dollar borrowings (E), the definition of the Euro-dollar reserve free base of September, 1969 (D_1), the definition of the Euro-dollar reserve free base of January, 1971 (D_2), and the time trend (T). The coefficients of the constant term, the government securities-Euro-dollar rate differential, the CD offer rate - Eurodollar rate differential, and the reserve requirement on savings and time deposits are insignificant. The coefficient of the discount rate-Euro-dollar rate differential is

TABLE 4.4^a

Ordinary Least Squares Estimates and Corrections for Auto-Correlation of the Static Equation

Dependent Variable - ESB_t

Equation number and correction procedure	Constant	g-b	c ₀ -b	f-cb	k-cb	X	c _s -Q	e	s	D ₁	D ₂	T	R ²	\bar{R}^2	ρ_1	ρ_2	D-W
(1)	-453.09 (-.656)	-240.26 (-.871)	-114.88 (-.505)	519.77 (2.302)	-566.35 (-2.439)		1,167.8 (4.644)	-359.54 (-2.493)	132.72 (.840)	4,392.8 (2.980)	4,753.8 (1.723)	102.92 (11.932)	.9809	.9782			.9137
(1) G.L.S.	-270.42 (-.5634)	-114.33 (-.404)	-268.04 (-1.100)	713.41 (4.004)	728.02 (-3.947)		859.33 (3.862)	-412.96 (-4.263)	65.76 (.394)	4,722.6 (4.639)	5,397.4 (3.247)	111.14 (11.966)			.739	-.391	1.662
(2)	-651.45 (-1.066)					-76.64 (-2.508)	1,715.9 (16.737)	-340.22 (-2.216)	250.99 (1.705)	4,157.0 (2.659)	3,788.4 (1.296)	102.17 (12.508)	.9774	.9752			1.0611
(2) G.L.S.	-421.36 (-.8304)					-41.23 (-1.642)	1,702.2 (15.267)	-394.01 (-3.369)	209.68 (1.183)	4,587.4 (3.778)	4,402.4 (2.105)	110.97 (11.319)			.575	-.253	1.701

^aSee note to Table 4.1.TABLE 4.5^a

Two Stage Least Squares Estimates and Corrections for Auto-Correlation of the Static Equation

Dependent Variable - ESB_t

Equation number and correction procedure	Constant	g-b	c ₀ -b	f-cb	k-cb	X	c _s -Q	e	s	D ₁	D ₂	T	R ²	\bar{R}^2	ρ_1	ρ_2	D-W
(1)	-19.20 (-.028)	-198.83 (-.7128)	-169.86 (-.752)	327.12 (1.294)	-825.25 (-3.871)		1,041.9 (3.968)	-354.04 (-2.500)	79.98 (.524)	3,707.3 (2.507)	4,597.7 (1.694)	99.09 (11.101)	.9816	.9790			.824
(1) G.L.S.	-143.4 (-.3407)	-207.57 (-.706)	-281.70 (-1.188)	627.38 (3.455)	-1,112.0 (-5.967)		584.78 (2.443)	-357.28 (-3.850)	57.38 (.345)	3,686.9 (3.726)	4,820.7 (3.017)	102.63 (10.501)			.729	-.299	1.637
(2)	-659.98 (-1.131)					-270.22 (-3.746)	1,354.5 (8.565)	-341.82 (-2.331)	239.88 (1.706)	3,742.6 (2.495)	3,842.9 (1.377)	92.46 (10.957)	.9794	.9774			.990
(2) G.L.S.	-487.31 (-1.044)					-257.12 (-3.613)	1,276.3 (7.650)	-384.34 (-3.539)	218.50 (1.289)	4,070.5 (3.569)	4,391.1 (2.271)	99.58 (9.921)			.599	-.249	1.866

^aSee note to Table 4.1.

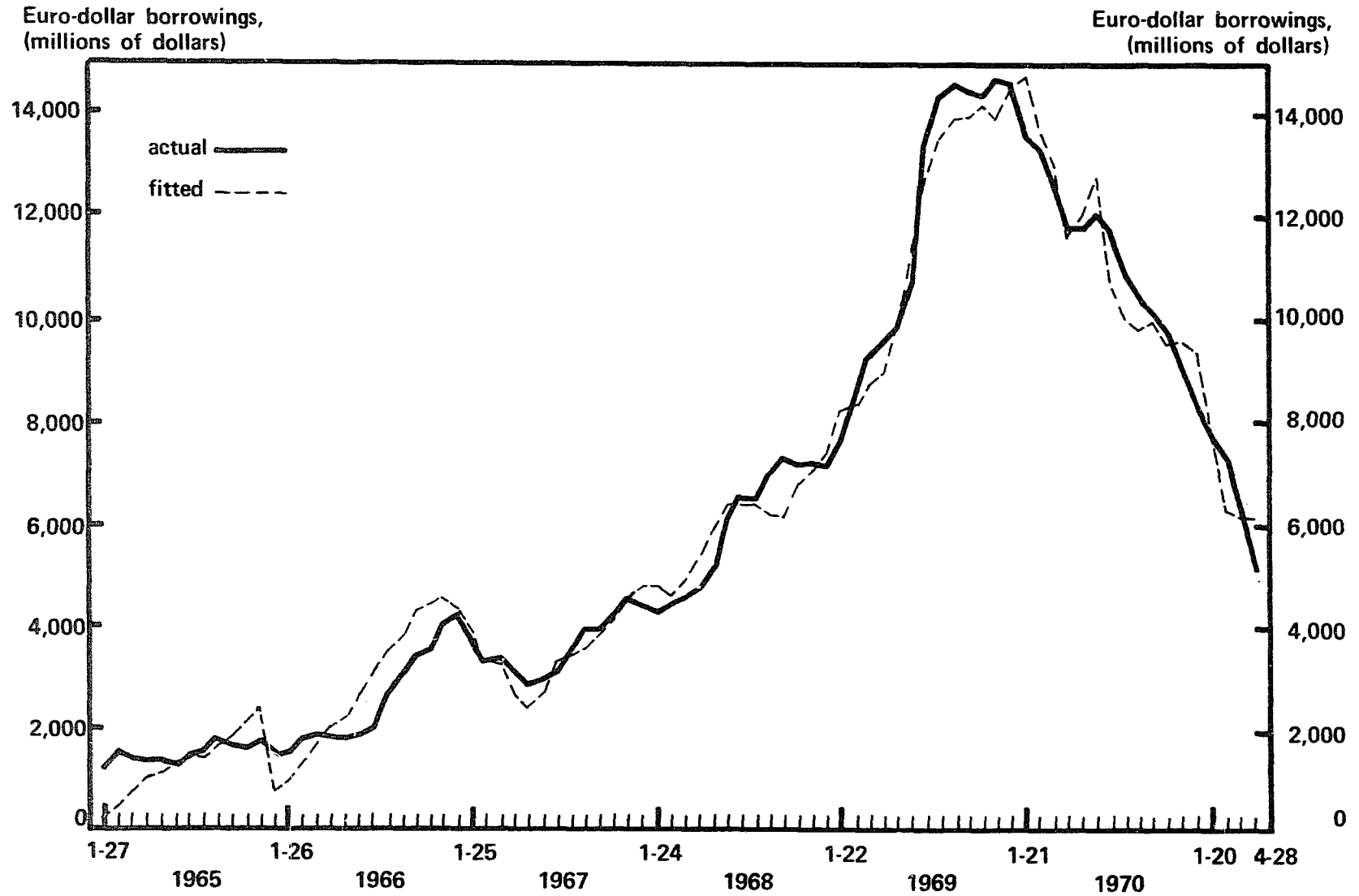
significant and negatively signed. Two stage least squares estimation (Table 4.5) does not result in considerably different estimates.

Evaluation of the Empirical Results

Estimation of the static equation lends strong support to the theory developed in this thesis, under the assumption that bankers adjust their Euro-dollar borrowings rapidly. Figure 4.1 depicts the estimated and actual values of Euro-dollar borrowings, and the close fit throughout the sample period (including the great increases of 1969 and great decreases of 1970 and early 1971) is offered as evidence of the theoretical model's explanatory value.

The estimated coefficients, with the exception of the coefficient of the discount rate-Euro-dollar rate differential, are consistent with much of the existing literature dealing with the Euro-dollar market. The insignificance of the 90-day interest rate differentials ($g-b$ and c_0-b) is wholly consistent with the general consensus that bankers use Euro-dollar borrowings as a day-to-day money instrument. The insignificance of the CD offer rate-Euro-dollar rate differential can also be attributed to the fact that bankers were effectively excluded by Regulation Q from issuing CDs during much of the sample period. The insignificance of the reserve requirement on savings and time deposits is attributable to the infrequency of changes in this requirement and the stability of savings and time deposits.

CHART 4.1
Two Stage Least Squares Estimation of the Static Equation
(Equation 1 of Table 4.5)



The relatively large coefficient of the proxy for the effect of Regulation Q on CD issues is consistent with the argument that banks resort to the Euro-dollar market when they are excluded from domestic sources of funds.

The large positive coefficient associated with D_2 indicates that the January, 1971 revisions of Regulations D and M did encourage bankers to maintain their reserve free Euro-dollar bases. It is not clear whether this action by bankers was in response to expected future Euro-dollar borrowings, which was the rationale appealed to in designing the January 1971 revisions, or to moral suasion by the Federal Reserve System, which is often cited as a cause by people within the System. The time trend of \$111 million per four-week period is consistent with Black's⁵ estimate of \$26 million per week ($26 \times 4 = 104$).

The call market rate spread differentials are significant, which is consistent with the view of Euro-dollar borrowings as a short-term money market instrument. The positive coefficient of the federal funds-Euro-dollar rate differential is wholly consistent with economic theory, while the negative coefficient of the discount rate-Euro-dollar rate differential is not. This inconsistency may result from the inadequacies of the discount rate as a measure of the effective cost of borrowing from the Federal Reserve System.⁶

⁵Stanley W. Black, "An Econometric Study."

⁶Several models of member bank borrowings from the Federal Reserve include borrowing reluctance and anticipated Federal Reserve (footnote continued on following page)

The negative coefficient of the discount rate-Euro-dollar rate differential may also be explained in part by the existence of influential moral suasion. Discount rate increases are often viewed as "subtle" announcements by the Federal Reserve System indicating their desire to tighten credit conditions. This announcement might encourage bankers to reduce their Euro-dollar borrowings, which would contribute to the inverse relationship between k -cb and Euro-dollar borrowings.

(footnote continued from preceding page)
harassment as variables in the estimation equation. These variables may be viewed as part of the effective cost of borrowing from the Federal Reserve System. Stephen M. Goldfield, and Edward J. Kane, "The Determinants of Member-bank Borrowing: An Econometric Study," Journal of Finance, Volume XXI (September, 1966), 499-514. Murray E. Polakoff, "Reluctance Elasticity, Least Cost, and Member Bank Borrowing: A Suggested Integration," Journal of Finance, Volume XV (March, 1960), 1-18.

CHAPTER V
SUMMARY AND POLICY PROPOSALS

Summary

A description of the Euro-dollar market, with particular emphasis on United States bank borrowings, has been presented. A utility maximization model of the demand for Euro-dollar borrowings by United States banks has been derived with profits, liquidity, and soundness as arguments. Empirical examination of the model has supported its explanatory value, and the empirical results have been found to be consistent with existing literature.

The empirical sample spans the period from early 1965 to April, 1971, and, unlike other published work on the subject, includes periods of significant changes in regulations governing United States bank behavior in the Euro-dollar market. It was found that an increase of 1 absolute percentage point in the Euro-dollar borrowings marginal reserve requirement is associated with an average decline of \$357 million in the level of Euro-dollar borrowings. An increase of 1 absolute percentage point in the difference between the secondary CD rate and the Regulation Q ceiling was found to be associated with an increase of \$584 million in Euro-dollar borrowings. The reserve free base of 1969 and its revision of 1971 were found to be significantly associated with increased levels of Euro-dollar borrowings.

Policy Proposals

The Federal Reserve System has control of two variables which are significantly associated with the level of Euro-dollar borrowings; the reserve requirement on Euro-dollar borrowings and the Regulation Q ceilings. In the past these tools have been used to counteract trends in Euro-dollar borrowings which were viewed as undesirable by the Federal Reserve. The potential of these instruments as positive policy tools has not been explored.

Monetary policy has often been afflicted with an inconsistency between its effects on domestic goals and balance of payments goals when the need for easy domestic monetary policy has existed in conjunction with balance of payments deficits. Monetary ease is generally associated with increasing income and increasing prices. As U. S. domestic income increases imports tend to be increased. As United States prices increase, United States goods become relatively more expensive in international markets and United States exports decline. Easy domestic monetary policy is typically viewed as increasing the balance of trade deficit, and thereby increasing the basic balance of payments deficit (which includes the balance of trade and long-term capital flows).

Operation twist of the early 1960s represents one attempt to use monetary policy as a viable tool during a period of unemployment and balance of payments deficits. Domestic investment was viewed as a function of long-term interest rates and international short-term capital flows were viewed as a function of short-term

interest rates. Operation twist was an attempt to maintain low long-term interest rates (to encourage domestic expansion) and allow short-term interest rates to rise (attracting short-term foreign capital). This policy was directed at the current account balance, not at the basic balance of payments. It was not an attempt to resolve the fundamental causes of the balance of payments deficit.

Robert Mundell's analysis indicates that monetary policy should be reserved for international stabilization while fiscal policy should be used for domestic stabilization.¹ This analysis is concerned with the basic balance of payments and the fundamental causes of international stability.

United States bank activity in the Euro-dollar market, and the Federal Reserve System's ability to influence this activity, may offer a means of using easy domestic monetary policy without increasing the risk of an exchange rate crisis. Although the Euro-dollar market does not offer a means of avoiding easy domestic monetary policy's negative effects on the basic balance of payments, it does offer a means of avoiding increases in the official balance of payments deficit.

Easy domestic monetary policy might be used to increase the total level of funds available to bankers, while Regulation Q and the reserve requirement on Euro-dollar borrowings are used to

¹Mundell, Robert A., "The Appropriate Use of Monetary and Fiscal Policy for Internal and External Stability," Readings in Money, National Income, and Stabilization Policy, Richard D. Irwin Inc., Homewood, Illinois, 1965, pp. 519-523.

influence the banker's choice of sources. If the Federal Reserve System were to use Regulation Q and the reserve requirement on Euro-dollar borrowings to encourage bankers to increase their Euro-dollar borrowings during periods of easy domestic monetary policy and balance of payments deficits, the official balance of payments deficit might be improved.

If Regulation Q ceilings and the reserve requirement on Euro-dollar borrowings were reduced to encourage increased Euro-dollar borrowings, the Euro-dollar rate could be expected to increase in response to the increased demand for Euro-dollars. This increased Euro-dollar rate could be expected to attract funds from domestic markets.

Whether or not increased Euro-dollar borrowings would improve the official balance of payments deficit depends, in part, on the relative magnitudes of the increase in Euro-dollar borrowings and the increase in United States funds flowing to the Euro-dollar market. Furthermore, the magnitude of the flow of funds from various foreign domestic financial markets to the Euro-dollar market and the effect of these flows on foreign exchange rates would influence the efficiency of Euro-dollar borrowings as a balance of payments policy tool. The entire notion of Euro-dollar borrowings as a tool for international stability depends on a system of relatively fixed exchange rates which are maintained by official monetary institutions.

Much theoretical and empirical work is needed to evaluate the control of Euro-dollar borrowings as a positive approach to the

inconsistencies between easy monetary policy at home during periods characterized by balance of payments deficits. Given the relative inflexibility of United States fiscal policy, the analysis might be well worth the effort.

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APPENDIX A

SOURCES OF DATA USED IN REGRESSIONS
(Alphabetically Listed)

- b: Daily observations of the 90-day Euro-dollar rate in the London market were received on tape from the Board of Governors of the Federal Reserve System.
- cb: Daily observations of the call market Euro-dollar rate were received on tape from the Board of Governors of the Federal Reserve System.
- c₀: Weekly observations of the range of CD offer rates at New York banks were obtained from the Federal Reserve Bank of New York. The midpoint of the range was used in the regressions of this thesis.
- c_s: Weekly average observations of the secondary CD market rate were obtained from the Federal Reserve System's "Weekly Summary of Banking and Credit Measures" (form H-9).
- e: Observations of the marginal reserve requirement on Euro-dollar borrowings are published in the Federal Reserve Bulletin.
- ESB: Aggregate observations of weekly averages of gross liabilities to own foreign branches are published in the Federal Reserve Bulletin.
- f: Observations of weekly averages of the federal funds rate were obtained from the Federal Reserve System's "Weekly Summary of Banking and Credit Measures" (form H-9).
- g: Observations of weekly averages of the 90-day government securities rate were obtained from the Federal Reserve System's "Weekly Summary of Banking and Credit Measures" (form H-9).
- G_c: Weekly observations of the German interbank loan rate and the 90-day forward exchange rate of the German mark vis-a-vis the U. S. dollar in the Frankfurt market were obtained from the Federal Reserve System's "Selected Interest and Exchange Rates for Major Countries and the U. S." (form H-13).
- G_i: Weekly observations of the German interbank call rate were obtained from the Federal Reserve System's "Selected Interest and Exchange Rates for Major Countries and the U. S." (form H-13).

- k: Observations of the Federal Reserve discount rate are published in the Federal Reserve Bulletin.
- Q: Regulation Q ceilings are published in the Federal Reserve Bulletin.
- r: Reserve requirements on demand deposits at Reserve City banks with deposits in excess of five million dollars were used. These rates are published in the Federal Reserve Bulletin.
- s: Reserve requirements on time deposits in excess of five million dollars were used. These requirements are published in the Federal Reserve Bulletin.
- UKc: Weekly observations of the United Kingdom local authority two-day deposit rate were obtained from the Federal Reserve System's "Selected Interest and Exchange Rates for Major Countries and the U. S." (form H-13).
- UKt: Weekly observations of the United Kingdom Treasury bill rate (adjusted to 90 days) and the three month forward exchange rate of the pound sterling vis-a-vis the dollar were obtained from the Federal Reserve System's "Selected Interest Rates and Exchange Rates for Major Countries and the U. S." (form H-13).

APPENDIX B

**REGULATIONS D AND M AS AMENDED EFFECTIVE
April 1, 1971**

BOARD OF GOVERNORS
of the
FEDERAL RESERVE SYSTEM

RESERVES OF MEMBER BANKS

REGULATION D

(12 CFR 204)

As amended effective February 12, 1970



Any inquiry relating to this regulation should be addressed to the Federal Reserve Bank of the Federal Reserve District in which the inquiry arises.

REGULATION D

(12 CFR 204)

As amended effective February 12, 1970

RESERVES OF MEMBER BANKS*

SECTION 204.1—DEFINITIONS

(a) **Demand deposits.** The term "demand deposits" includes all deposits except "time deposits" as defined below.

(b) **Time deposits.** The term "time deposits" means "time certificates of deposit", "time deposits, open account", and "savings deposits", as defined below; except that for the purposes of § 204.5(c) "time deposits" shall have the meaning set forth therein.

(c) **Time certificates of deposit.** The term "time certificate of deposit" means a deposit evidenced by a negotiable or nonnegotiable instrument which provides on its face that the amount of such deposit is payable to bearer or to any specified person or to his order:

(1) On a certain date, specified in the instrument, not less than 30 days after the date of deposit, or

(2) At the expiration of a certain specified time not less than 30 days after the date of the instrument, or

(3) Upon notice in writing which is actually required to be given not less than 30 days before the date of repayment,¹ and

(4) In all cases only upon presentation and surrender of the instrument.

* The text corresponds to the Code of Federal Regulations, Title 12, Chapter II, Part 204; cited as 12 CFR 204. The words "this Part", as used herein, mean Regulation D.

¹ A deposit with respect to which the bank merely reserves the right to require notice of not less than 30 days before any withdrawal is made is not a "time certificate of deposit".

(d) **Time deposits, open account.** The term "time deposit, open account" means a deposit, other than a "time certificate of deposit", with respect to which there is in force a written contract with the depositor that neither the whole nor any part of such deposit may be withdrawn, by check or otherwise, prior to the date of maturity, which shall be not less than 30 days after the date of the deposit,² or prior to the expiration of the period of notice which must be given by the depositor in writing not less than 30 days in advance of withdrawal.³

(e) **Savings deposits.** The term "savings deposit" means a deposit—

(1) which consists of funds deposited to the credit of one or more individuals, or of a corporation, association, or other organization operated primarily for religious, philanthropic, charitable, educational, fraternal, or other similar purposes and not operated for profit;⁴ or in which the en-

² Deposits, such as Christmas club accounts and vacation club accounts, which are made under written contracts providing that no withdrawal shall be made until a certain number of periodic deposits have been made during a period of not less than 3 months constitute "time deposits, open account" even though some of the deposits are made within 30 days from the end of the period.

³ A deposit with respect to which the bank merely reserves the right to require notice of not less than 30 days before any withdrawal is made is not a "time deposit, open account", within the meaning of the above definition.

⁴ Deposits in joint accounts of two or more individuals may be classified as savings deposits if they meet the other requirements of the above definition, but deposits of a partnership operated for profit may not be so classified. Deposits to the credit of an individual of funds in which any beneficial interest is held by a corporation, partnership, association, or other organization operated for profit or not operated primarily for religious, philanthropic, charitable, educational, fraternal, or other similar purposes may not be classified as savings deposits.

ture beneficial interest is held by one or more individuals or by such a corporation, association, or other organization; and

(2) with respect to which the depositor is not required by the deposit contract but may at any time be required by the bank to give notice in writing of an intended withdrawal not less than 30 days before such withdrawal is made⁶ and which is not payable on a specified date or at the expiration of a specified time after the date of deposit.

(f) **Deposits as including certain promissory notes and other obligations.** For the purposes of this Part, the term "deposits" also includes a member bank's liability on any promissory note, acknowledgment of advance, due bill, or similar obligation (written or oral) that is issued or undertaken by a member bank principally as a means of obtaining funds to be used in its banking business, except any such obligation that:

(1) is issued to (or undertaken with respect to) and held for the account of (i) a domestic banking office^{7a} of another bank or (ii) an agency of the United States or the Government Development Bank for Puerto Rico;

(2) evidences an indebtedness arising from a transfer of direct obligations of, or obligations that are fully guaranteed as to principal and interest by, the United States or any agency thereof that the bank is obligated to repurchase;

(3) has an original maturity of more than two years, is unsecured, and states expressly that it is subordinated to the claims of depositors; or

(4) arises from a borrowing by a member bank from a dealer in securities, for one business day, of proceeds of a transfer of deposit credit in a Federal Reserve Bank (or other immediately available funds), commonly referred to as "Federal funds", received by such dealer on the date of the loan in connection with clearance of securities transactions.

This paragraph shall not, however, affect (i) any instrument issued before June 27, 1966, (ii) any instrument that evidences an indebtedness arising from a transfer of assets under repurchase agreement issued before July 25, 1969, or (iii) any instrument issued to a foreign office of another bank before June 27, 1969.

(g) **Gross demand deposits.** The term "gross demand deposits" means the sum of all demand de-

posits, including demand deposits to the credit of other banks, the United States, States, counties, school districts, and other governmental subdivisions and municipalities, and all outstanding certified and officers' checks (including checks issued by the bank in payment of dividends and checks or drafts drawn by or on behalf of a foreign branch of a member bank on an account maintained by such a branch with a domestic office of the parent bank), and letters of credit and travelers' checks sold for cash.

(h) **Cash items in process of collection.** The term "cash items in process of collection" means:

(1) Checks in process of collection, drawn on a bank, private bank, or any other banking institution, which are payable immediately upon presentation in the United States, including checks with a Federal Reserve Bank in process of collection and checks on hand which will be presented for payment or forwarded for collection on the following business day;

(2) Government checks and warrants drawn on the Treasurer of the United States which are in process of collection;

(3) Such other items in process of collection, payable immediately upon presentation in the United States, as are customarily cleared or collected by banks as cash items.

Items handled as noncash collections may not be treated as "cash items in process of collection" within the meaning of this Part.

(i) **Net demand deposits.** The term "net demand deposits" means gross demand deposits as defined in paragraph (g) of this section less the deductions allowed under the provisions of § 204.2(b).

(j) **Currency and coin.** The term "currency and coin" means United States currency and coin owned and held by a member bank, including currency and coin in transit to or from a Federal Reserve Bank.

SECTION 204.2—COMPUTATION OF RESERVES

(a) **Amounts of reserves to be maintained.** (1) Every member bank shall maintain on deposit with the Federal Reserve Bank of its district an actual net balance equal to 3 per cent of its time deposits, plus 7 per cent of its net demand deposits if it is not located in a reserve city or 10 per cent of its net demand deposits if it is located in a reserve city, or such different percentages of its time deposits and net demand deposits as the Board of Governors of the Federal Reserve Sys-

⁶ The exercise by the bank of its right to require such notice shall not cause the deposit to cease to be a savings deposit.

^{7a} Any banking office in any State of the United States or the District of Columbia of a bank organized under domestic or foreign law.

tem, pursuant to and within the limitations contained in section 19 of the Federal Reserve Act, may prescribe from time to time in § 204.5 (the Supplement to this Part): *Provided*, That a member bank's currency and coin shall be counted as reserves in determining compliance with such requirements to such extent as the Board of Governors of the Federal Reserve System, pursuant to section 19 of the Federal Reserve Act, may permit from time to time in § 204.5.

(2) Notwithstanding the provisions of subparagraph (1) of this paragraph, a member bank located in a reserve city may hold and maintain the reserve balances which are in effect for member banks not located in reserve cities if, upon application to the Board of Governors, the Board grants permission for the holding and maintaining of such lower reserve balances after consideration of all factors relating to the character of such bank's business, including, but not limited to, the amount of such member bank's total assets, the amount of its total deposits, the amount of its total demand deposits, the amount of its demand deposits owing to banks, the nature of its depositors and borrowers, the rate of activity of its demand deposits, its geographical location within the city, and its competitive position with relation to other banks in the city. Any such permission shall be subject to revocation by the Board at any time in the light of changed circumstances, and all such grants of permission may be subject to annual review by the Board.

(3) For the purposes of this Part, a member bank shall be considered to be in a reserve city if the head office or any branch thereof is located in a reserve city.

(b) **Deductions allowed in computing reserves.** In determining the reserve balances required under the terms of this Part, member banks may deduct from the amount of their gross demand deposits the amounts of balances subject to immediate withdrawal due from other banks and cash items in process of collection as defined in § 204.1(h). Balances "due from other banks" do not include balances due from Federal Reserve Banks, balances (payable in dollars or otherwise) due from foreign banks or branches thereof wherever located, or balances due from foreign branches of domestic banks.⁹

⁹ A member bank exercising fiduciary powers may not include in balances "due from other banks" amounts of trust funds deposited with other banks and due to it as trustee or other fiduciary. If trust funds are deposited by

(c) **Availability of cash items as reserve.** Cash items forwarded to a Federal Reserve Bank for collection and credit cannot be counted as part of the minimum reserve balance to be carried by a member bank with its Federal Reserve Bank until the expiration of such time as may be specified in the appropriate time-schedule referred to in Part 210 of this chapter. If a member bank draws against items before such time, the draft will be charged against its reserve balance if such balance be sufficient in amount to pay it; but any resulting impairment of reserve balances will be subject to the penalties provided by law and by this Part: *Provided, however*, That the Federal Reserve Bank may, in its discretion, refuse at any time to permit the withdrawal or other use of credit given in its reserve account for any item for which the Federal Reserve Bank has not received payment in actually and finally collected funds.

(d) **Reserves against trust funds.** A member bank exercising trust powers need not maintain reserves against trust funds which it keeps properly segregated as trust funds and apart from its general assets or which it deposits in another institution to the credit of itself as trustee or other fiduciary. If, however, such funds are mingled with the general assets of the bank, a deposit liability thereby arises against which reserves must be maintained.

(e) **Continuance of "time deposit" status.** A deposit which at the time of deposit was a "deposit evidenced by a time certificate of deposit", "time deposit, open account", or "savings deposit" continues to be a "time deposit" until maturity or the expiration of the period of notice of withdrawal, although it has become payable within 30 days. After the date of maturity of any time deposit, such deposit is a demand deposit. After the expiration of the period of notice given with respect to the repayment of any savings deposit or other time deposit, such deposit is a demand deposit, except that, if the owner of such deposit advise the bank in writing that the deposit will not be withdrawn pursuant to such notice or that the deposit will thereafter again be subject to the contract or requirements applicable to such deposit, the deposit will again constitute a savings deposit or other time deposit, as the case may be, after

the trust department of a member bank in its commercial or savings department and are then redeposited in another bank subject to immediate withdrawal they may be included by the member bank in balances "due from other banks", subject to the provisions of § 204.2(b).

the date upon which such advice is received by the bank.

SECTION 204.3—DEFICIENCIES IN RESERVES

(a) **Computation of deficiencies.** (1) Reserve requirements of all member banks shall be determined on the basis of average daily net deposit balances and average daily currency and coin covering 7-day computation periods which shall end at the close of business on Wednesday of each week.

(2) In determining whether a member bank has maintained a reserve balance that is in excess of or less than its required reserve balance for any computation period:

(i) The required reserve balance of such bank shall be based upon the average daily net deposit balances held by the member bank at the close of business each day during the second computation period prior to the computation period for which the computation is made.

(ii) The reserve balance of such bank shall consist of the average daily balance with the Federal Reserve Bank of its District held by the member bank at the close of business of each day during the computation period for which the computation is made and the average daily currency and coin held by the member bank at the close of business each day during the second computation period prior to the computation period for which the computation is made.

(3) Any excess or deficiency in a member bank's required reserve balance for any computation period, determined as provided in subparagraph (2) above, will be carried forward to the next following computation period to the extent that such excess or deficiency does not exceed 2 per cent of such required reserves, except that any portion of such excess or deficiency not offset in the next period may not be carried forward to additional computation periods.

(b) **Penalties.** (1) Deficiencies in reserve balances remaining after the application of subparagraph (3) of paragraph (a) above will be subject to penalties, assessed monthly on the basis of aver-

age daily deficiencies during each of the computation periods ending in the preceding calendar month.

(2) Any such penalty will be assessed at a rate of 2 per cent per annum above the lowest rate applicable to borrowings by each member bank from its Federal Reserve Bank on the first day of the calendar month in which the deficiencies occurred.

(c) **Notice to directors of banks deficient in reserves.** Whenever it shall appear that a member bank is not paying due regard to the maintenance of its reserves, the Federal Reserve Bank shall address a letter to each director of such bank calling attention to the situation and advising him of the requirements of the law and of this Part regarding the maintenance of reserves.

(d) **Continued deficiencies.** If, after the notice provided for in paragraph (c) of this section has been given, it shall appear that the member bank is continuing its failure to pay due regard to the maintenance of its reserves, the Federal Reserve Bank shall report such fact to the Board of Governors of the Federal Reserve System with a recommendation as to whether or not the Board should:

(1) In the case of a national bank, direct the Comptroller of the Currency to bring suit to forfeit the charter of such national bank pursuant to section 2 of the Federal Reserve Act (38 Stat. 252; 12 U.S.C. 501a); or

(2) In the case of a State member bank, institute proceedings to require such bank to surrender its stock in the Federal Reserve Bank and to forfeit all rights and privileges of membership pursuant to section 9 of the Federal Reserve Act (46 Stat. 251; 12 U.S.C. 327); or

(3) In either case, take such other action as the Federal Reserve Bank may recommend or the Board of Governors of the Federal Reserve System may consider advisable.

(SECTION 204.5—SUPPLEMENT, containing reserve percentages and use of vault cash in meeting reserve requirements, is printed separately.)

STATUTORY APPENDIX

Section 19 of the Federal Reserve Act provides in part as follows:

(a) The Board is authorized for the purposes of this section to define the terms used in this section, to determine what shall be deemed a payment of interest, to determine what types of obligations, whether issued directly by a member bank or indirectly by an affiliate of a member bank or by other means, shall be deemed a deposit, and to prescribe such regulations as it may deem necessary to effectuate the purposes of this section and to prevent evasions thereof.

(b) Every member bank shall maintain reserves against its deposits in such ratios as shall be determined by the affirmative vote of not less than four members of the Board within the following limitations:

(1) In the case of any member bank in a reserve city, the minimum reserve ratio for any demand deposit shall be not less than 10 per centum and not more than 22 per centum, except that the Board, either in individual cases or by regulation, on such basis as it may deem reasonable and appropriate in view of the character of business transacted by such bank, may make applicable the reserve ratios prescribed for banks not in reserve cities.

(2) In the case of any member bank not in a reserve city, the minimum reserve ratio for any demand deposit shall be not less than 7 per centum and not more than 14 per centum.

(3) In the case of any deposit other than a demand deposit, the minimum reserve ratio shall be not less than 3 per centum and not more than 10 per centum.

The Board may, however, prescribe any reserve ratio, not more than 22 per centum, with respect to any indebtedness of a member bank that arises out of a transaction in the ordinary course of its banking business with respect to either funds received [from] or credit extended by such bank to a bank organized under the law of a foreign country or a dependency or insular possession of the United States.

(c) Reserves held by any member bank to meet the requirements imposed pursuant to subsection (b) of this section shall be in the form of—

(1) balances maintained for such purposes by such bank in the Federal Reserve bank of which it is a member, and

(2) the currency and coin held by such bank, or such part thereof as the Board may by regulation prescribe.

[U.S.C., title 12, sec. 461.]

* * *

(f) The required balance carried by a member bank with a Federal Reserve bank may, under the regulations and subject to such penalties as may be prescribed by the Board of Governors of the Federal Reserve System, be checked against and withdrawn by such member bank for the purpose of meeting existing liabilities.

[U.S.C., title 12, sec. 464.]

(g) In estimating the reserve balances required by this Act, member banks may deduct from the amount to their gross demand deposits the amounts of balances due from other banks (except Federal Reserve banks and foreign banks) and cash items in process of collection payable immediately upon presentation in the United States, within the meaning of these terms as defined by the Board of Governors of the Federal Reserve System.

[U.S.C., title 12, sec. 465.]

Section 11 of the Federal Reserve Act provides in part as follows:

The Board of Governors of the Federal Reserve System shall be authorized and empowered:

* * *

(c) To suspend for a period not exceeding thirty days, and from time to time to renew such suspensions for periods not exceeding fifteen days, any reserve requirements specified in this Act.

[U.S.C., title 12, sec. 248(c).]

* * *

(e) To add to the number of cities classified as reserve cities under existing law in which national banking associations are subject to the reserve requirements set forth in section [nineteen] of this Act; or to reclassify existing reserve cities or to terminate their designation as such.

[U.S.C., title 12, sec. 248(e).]

* * *

BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM

SUPPLEMENT TO REGULATION D

As amended effective February 12, 1970

SECTION 204.5—SUPPLEMENT

(a) **Reserve percentages.** Pursuant to the provisions of section 19 of the Federal Reserve Act and § 204.2(a) and subject to paragraphs (b) and (c) of this section, the Board of Governors of the Federal Reserve System hereby prescribes the following reserve balances which each member bank of the Federal Reserve System is required to maintain on deposit with the Federal Reserve Bank of its district:

(1) **If not in a reserve city—**

(i) 3 per cent of (a) its savings deposits and (b) its time deposits, open account, that constitute deposits of individuals, such as Christmas club accounts and vacation club accounts, that are made under written contracts providing that no withdrawal shall be made until a certain number of periodic deposits have been made during a period of not less than 3 months; plus

(ii) 3 per cent of its other time deposits up to \$5 million, plus 6 per cent of such deposits in excess of \$5 million; plus

(iii) 12½ per cent of its net demand deposits up to \$5 million, plus 13 per cent of such deposits in excess of \$5 million.

(2) **If in a reserve city** (except as to any bank located in such a city which is permitted by the Board of Governors of the Federal Reserve System, pursuant to § 204.2(a)(2), to maintain the reserves specified in subparagraph (1) of this paragraph)—

(i) 3 per cent of (a) its savings deposits and (b) its time deposits, open account, that constitute deposits of individuals, such as Christmas club accounts and vacation club accounts, that are made under written contracts providing that no withdrawal shall be made until a certain number of periodic deposits have been made during a period of not less than 3 months; plus

(ii) 3 per cent of its other time deposits up to \$5 million, plus 6 per cent of such deposits in excess of \$5 million; plus

(iii) 17 per cent of its net demand deposits up to \$5 million, plus 17½ per cent of such deposits in excess of \$5 million.

(b) **Currency and coin.** The amount of a member bank's currency and coin shall be counted as reserves in determining compliance with the reserve requirements of paragraph (a) of this section.

(c) **Reserve percentages against certain deposits by foreign banking offices.** Deposits represented by promissory notes, acknowledgments of advance, due bills, or similar obligations described in § 204.1(f) to foreign offices of other banks,⁹ or institutions the time deposits of which are exempt from the rate limitations of Regulation Q pursuant to § 217.3(g) thereof, shall not be subject to paragraph (a) of this section or to § 204.3(a)(1) and (2); but during each week of the four-week period beginning October 16, 1969, and during each week of each successive four-week ("maintenance") period, a member bank shall maintain with the Reserve Bank of its district a daily average balance equal to 10 per cent of the daily average amount of such deposits during the four-week ("computation") period ending on the Wednesday fifteen days before the beginning of the maintenance period; except that only 3 per cent need be so maintained against such deposits which are time deposits¹⁰ aggregating not more than 4 per cent of such member bank's daily average deposits subject to paragraph (a) of this section during the computation period. An excess or deficiency in reserves in any week of a maintenance period under this paragraph shall be subject to § 204.3(a)(3), as if computed under § 204.3(a)(2), and deficiencies under this paragraph shall be subject to § 204.3(b).¹⁰

⁹ I.e., offices of other banks not covered by § 204.1(f)(1).

⁹ For the purposes of this paragraph, "time deposits" means any deposit having a maturity of one day or more.

¹⁰ The term "computation period" in § 204.3(a)(3) and (b) shall, for this purpose, be deemed to refer to each week of a maintenance period under this paragraph.

AMENDMENT TO REGULATION D

ISSUED BY THE BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM

PART 204—RESERVES OF MEMBER BANKS

RESERVES AGAINST EURODOLLAR BORROWINGS

1. Effective January 7, 1971, section 204.5 (c) is amended to read as follows:

SECTION 204.5 RESERVE REQUIREMENTS

* * *

(c) **Reserve percentages against certain deposits by foreign banking offices.** Deposits represented by promissory notes, acknowledgments of advance, due bills, or similar obligations described in section 204.1(f) to foreign offices of other banks,⁸ or institutions the time deposits of which are exempt from the rate limitations of Regulation Q pursuant to section 217.3(g) thereof, shall not be subject to paragraph (a) of this section or to section 204.3 (a)(1) and (2); but during each week of the four-week period beginning October 16, 1969, and during each week of each successive four-week ("maintenance") period, a member bank shall maintain with the Reserve Bank of its district a daily average balance equal to 20 per cent of the amount by which the daily average amount of such deposits during the four-week ("computation") period ending on the Wednesday fifteen days before the beginning of the maintenance period exceeds the lesser of (i) 3 per cent of such member bank's daily average deposits subject to paragraph (a) of this section during the current computation period or during the computation period ending November 25, 1970, whichever is greater, or (ii) the lowest corresponding daily average total for any computation period beginning on or after December 24, 1970. An excess or deficiency in reserves in any week of a maintenance period under this paragraph shall be subject to section 204.3(a)(3), as if computed under section 204.3(a)(2), and deficiencies under this paragraph shall be subject to section 204.3 (b).⁹

* * *

2a. These amendments are issued pursuant to the authority granted to the Board of Governors by section 19 of the Federal Reserve

⁸ Any banking office located outside the States of the United States and the District of Columbia of a bank organized under domestic or foreign law.

⁹ The term "computation period" in section 204.3 (a)(3) and (b) shall, for this purpose, be deemed to refer to each week of a maintenance period under this paragraph.

Act to set reserve ratios (12 U.S.C. 461) and by sections 25 and 9 of that Act to regulate foreign branches of member banks (12 U.S.C. 601 and 321). The principal change is to raise from 10 to 20 per cent the reserve ratio applicable to a member bank's Eurodollar borrowings to the extent they exceed a specified reserve-free base. This change becomes effective as to maintenance periods beginning January 7, 1971, as to reserve computation periods ending December 23, 1970. To prevent the higher marginal reserve requirement from having the effect of penalizing banks that during the computation period ending November 25, 1970, had Eurodollar borrowings above their reserve-free bases, the higher marginal reserve requirement will apply to borrowings above the higher of (a) the minimum base of 3 per cent of deposits, or (b) the average level of borrowings in the computation period ending November 25, 1970.

b. The second major change applies an automatic downward adjustment feature to the minimum reserve-free bases applicable to Eurodollar borrowings. Such a feature is presently operative under Regulation M with respect to historical reserve-free bases. The effect of this amendment is to eliminate the reserve-free minimum base to the extent a bank elects not to make use of it. This change becomes effective as to reserve computation periods beginning December 24, 1970.

c. The final change is technical. It provides, under Regulation D, a reserve-free minimum base with respect to reserve requirements against member bank borrowings from foreign banking offices. This change is designed to conform the approach of reserve requirements applicable to Eurodollar borrowings under Regulation D with the approach under Regulation M, which relates to Eurodollar borrowings by domestic offices from their foreign branches. This change becomes effective as to maintenance periods beginning January 7, 1971, as to reserve computation periods ending December 23, 1970.

d. There was no notice and public participation with respect to these amendments, and in some respects the effective date was deferred for less than the 30 days referred to in section 553(d) of Title 5, United States Code. The Board found that following such procedures with respect to these amendments would be contrary to the public interest and serve no useful purpose.

**BOARD OF GOVERNORS
of the
FEDERAL RESERVE SYSTEM**

FOREIGN ACTIVITIES OF NATIONAL BANKS

REGULATION M

(12 CFR 213)

As amended effective January 7, 1971



Any inquiry relating to this regulation should be addressed to the Federal Reserve Bank of the Federal Reserve district in which the inquiry arises.

REGULATION M

(12 CFR 213)

As amended effective January 7, 1971

FOREIGN ACTIVITIES OF NATIONAL BANKS *

SECTION 213.1—AUTHORITY AND SCOPE¹

Pursuant to authority conferred upon it by section 25 of the Federal Reserve Act (the "Act"), as amended (12 U.S.C. 601-604a), the Board of Governors of the Federal Reserve System (the "Board") prescribes the following regulations relating to (a) foreign branches of national banks, (b) the acquisition and holding of stock in foreign banks by national banks, and (c) loans or extensions of credit to or for the account of such foreign banks by national banks.²

SECTION 213.2—DEFINITIONS

For the purposes of this Part—

(a) **"Foreign branch"** means any branch established by a national bank pursuant to section 25 of the Act.

(b) **"Foreign country"** or **"country"** means any foreign nation or colony, dependency, or possession thereof, any overseas territory, dependency, or insular possession of the United States, or the Commonwealth of Puerto Rico.

(c) **"Foreign bank"** means a bank organized under the law of a foreign country and not engaged, directly or indirectly, in any activity in the United States except as, in the judgment of the Board, shall be incidental to the international or foreign business of such foreign bank.

* This text corresponds to the Code of Federal Regulations, Title 12, Chapter II, Part 213, cited as 12 CFR 213. The words "this Part," as used herein, mean Regulation M.

¹ Insofar as provisions of Federal law are concerned, the provisions of this Part apply to State member banks of the Federal Reserve System as well as to national banks.

² The subject matter of this Part is in addition to that contained in 12 CFR Part 211 (Reg. K).

SECTION 213.3—FOREIGN BRANCHES

(a) **Establishing foreign branches.** A foreign branch may be established with prior Board permission. If a national bank has established a branch in a foreign country, it may, unless otherwise advised by the Board, establish other branches in that country after thirty days' notice to the Board with respect to each such branch.

(b) **Further powers of foreign branches.** In addition to its other powers, a foreign branch may, subject to §§ 213.3(c) and 213.6 and *so far as usual in connection with the transaction of the business of banking in the places where it shall transact business:*

(1) Guarantee customers' debts or otherwise agree for their benefit to make payments on the occurrence of readily ascertainable events,³ if the guarantee or agreement specifies its maximum monetary liability thereunder; but, except to the extent secured with respect thereto, no national bank may have such liabilities outstanding (i) in an aggregate amount exceeding 50 per cent of its capital and surplus or (ii) for any customer in excess of the amount by which 10 per cent of its capital and surplus exceeds the aggregate of such customer's "obligations" to it which are subject to any limitation under section 5200 of the Revised Statutes (12 U.S.C. 84);

(2) Accept drafts or bills of exchange drawn upon it, which shall be treated as "commercial drafts or bills" for the purposes of paragraphs (c), (d), and (e) of § 203.1 of Part 203 (Reg. C);

(3) Acquire and hold securities (including certificates or other evidences of ownership or participation) of the central bank, clearing houses, governmental entities, and development banks of the country in which it is located, unless after such an acquisition the aggregate amount invested by the branch in such securities (exclusive of securities held as required by the law of that country or as authorized under section 5136 of the Revised Statutes (12 U.S.C. 24)) would exceed one per cent of its total deposits on the preceding year-end call report date (or on the

³ Including, but not limited to, such types of events as nonpayment of taxes, rentals, customs duties, or costs of transport and loss or nonconformance of shipping documents.

date of such acquisition in the case of a newly established branch which has not so reported);

(4) Underwrite, distribute, buy, and sell obligations of the national government of the country in which it is located,⁴ but no bank may hold, or be under commitment with respect to, obligations of such a government as a result of underwriting, dealing in, or purchasing for its own account in an aggregate amount exceeding 10 per cent of its capital and surplus;

(5) Take liens or other encumbrances on foreign real estate in connection with its extensions of credit, whether or not of first priority and whether or not such real estate is improved or has been appraised, and without regard to the maturity or amount limitations or amortization requirements of section 24 of the Act (12 U.S.C. 371);

(6) Extend credit to an executive officer of the branch in an amount not to exceed \$50,000 or its equivalent in order to finance the acquisition or construction of living quarters to be used as his residence abroad, provided each such credit extension is promptly reported to its home office;

(7) Pay to any officer or employee of the branch a greater rate of interest on deposits than that paid to other depositors on similar deposits with the branch.

(c) **Limitations.** Nothing in § 213.3(b) shall authorize a foreign branch to engage in the general business of producing, distributing, buying, or selling goods, wares, or merchandise or, except as permitted by § 213.3(b) (4), to engage or participate, directly or indirectly, in the business of underwriting, selling, or distributing securities.

(d) **Suspending operations during disturbed conditions.** The officer in charge of a foreign branch may suspend its operations during disturbed conditions which, in his judgment, make conduct of such operations impracticable; but every effort shall be made before and during such suspension to serve its depositors and customers. Full information concerning any such suspension shall be promptly reported to the branch's home office, which shall immediately send a copy thereof to the Board through the Federal Reserve Bank of its district.

⁴ Including obligations issued by any agency or instrumentality, and supported by the full faith and credit, of such government.

SECTION 213.4—ACQUISITION AND HOLDING OF STOCK IN FOREIGN BANKS

(a) **General.** With the prior consent of the Board, and subject to the provisions of section 25 of the Act and this Part, a national bank may acquire and hold directly or indirectly⁵ the stock or other evidences of ownership in one or more foreign banks: *Provided*, That the aggregate amount invested directly or indirectly (other than through a corporation operating under section 25 of the Act or organized under section 25(a) of the Act) in the stock or other evidences of ownership of all foreign banks, taken together with investments by the national bank in the shares of corporations operating under section 25 of the Act or organized under section 25(a) of the Act, shall not exceed 25 per cent of the national bank's capital and surplus. Nothing contained in this Part shall prevent the acquisition and holding of stock or other evidences of ownership in a foreign bank where such acquisition is necessary to prevent a loss upon a debt previously contracted in good faith; but such stock or other evidences of ownership shall be disposed of within twelve months from the date of acquisition unless such time is extended by the Board.

(b) **Limitations.** Stock or other evidences of ownership in a foreign bank shall be disposed of as promptly as practicable if (1) such bank should engage in the business of underwriting, selling, or distributing securities in the United States or (2) the national bank is advised by the Board that its holding is inappropriate under section 25 of the Act or this Part. The terms "stock", "shares", and "evidences of ownership" in this section include any right to acquire stock, shares, or evidences of ownership, except that prior Board consent is not required for the acquisition and exercise of stock rights in lieu of dividends which are declared on shares already held by a national bank and which do not result in an increase in percentage ownership of the foreign bank.

(c) **Required information.** A national bank applying for the consent of the Board to acquire and hold stock or other evidences of ownership

⁵ However, prior consent of the Board is not required hereunder for indirect acquisitions in the stock of foreign banks made pursuant to the general consent provisions of § 211.8 of Part 211 (Reg. K).

in a foreign bank pursuant to this section shall furnish full information concerning such foreign bank including (unless previously furnished): (1) the cost, number, and class of shares to be acquired, and the proposed carrying value of such shares on the books of the national bank; (2) recent balance sheet and income statement of the foreign bank; (3) brief description of the foreign bank's business (including full information concerning any direct or indirect business transacted in the United States); (4) lists of directors and principal officers (with address and principal business affiliation of each) and of all shareholders known to the issuing bank holding 10 per cent or more of any class of the foreign bank's stock or other evidences of ownership, and the amount held by each; and (5) information concerning the rights and privileges of the various classes of shares outstanding.

(d) **Reports.** A national bank shall immediately inform the Board through the Federal Reserve Bank of its district with respect to any acquisition or disposition of stock in a foreign bank including the cost and number of shares acquired pursuant to this section.

SECTION 213.5—LOANS OR EXTENSIONS OF CREDIT TO FOREIGN BANKS

A national bank which holds directly or indirectly⁶ stock or other evidences of ownership in a foreign bank may make loans or extensions of credit to or for the account of such foreign bank without regard to the provisions of section 23A of the Act (12 U.S.C. 371c).

SECTION 213.6—CONDITIONS

(a) The continued or prospective exercise of any power under this Part shall be subject to any notice interpreting or applying it that a national bank may receive from the Board, and such bank shall immediately comply therewith.

(b) The Board may from time to time require a national bank to make reports at such time and in such form as the Board may prescribe regarding the exercise of any power hereunder and to submit information regarding compliance with this Part.

⁶ Whether through a corporation operating under section 25 of the Act or organized under section 25(a) of the Act, or otherwise.

SECTION 213.7—RESERVES AGAINST FOREIGN BRANCH DEPOSITS

(a) **Transactions with parent bank.** During each week of the four-week period beginning October 16, 1969, and during each week of each successive four-week ("maintenance") period, a member bank having one or more foreign branches shall maintain with the Reserve Bank of its district, as a reserve against its foreign branch deposits, a daily average balance equal to 20 per cent of the amount by which the daily average total of

(1) net balances due from its domestic offices to such branches, and

(2) assets (including participations) held by such branches which were acquired from its domestic offices,⁷

during the four-week ("computation") period ending on the Wednesday fifteen days before the beginning of the maintenance period, exceeds the greater of

(i) the corresponding daily average total⁸ for the computation period ending November 25, 1970, or the lowest corresponding daily average total for any computation period beginning after that date, whichever amount is the lesser, or

(ii) 3 per cent of the member bank's daily average deposits subject to § 204.5(a) of this chapter (Regulation D) during the current computation period, or, if the bank has had a foreign branch in operation for more than 90 days, the lowest corresponding daily average total for any computation period beginning on or after December 24, 1970, whichever amount is the lesser:

⁷ Excluding (1) assets so held on June 26, 1969, representing credit extended to persons not residents of the United States and (2) credit extended or renewed by a domestic office after June 26, 1969, to persons not residents of the United States to the extent such credit was not extended in order to replace credit outstanding on that date which was paid prior to its original maturity (see definition of United States resident in footnote 9).

⁸ Excluding assets representing credit extended to persons not residents of the United States.

Provided, That the applicable base computed under (i) or (ii) shall be reduced by the daily average amount of any deposits of the member bank subject to § 204.5(c) of this chapter (Regulation D) during the computation period.

(b) **Credit extended to United States residents.** During each week of the four-week period beginning October 16, 1969, and during each week of each successive four-week maintenance period, a member bank having one or more foreign branches shall maintain with the Reserve Bank of its district, as a reserve against its foreign branch deposits, a daily average balance equal to 20 per cent of the amount by which daily average credit outstanding from such branches to United States residents⁹ (other than assets acquired and net balances due from its domestic offices), during the four-week computation period ending on Wednesday fifteen days before the beginning of the maintenance period, exceeds the corresponding daily average total during the four-week period ending on November 25, 1970: *Provided*, That this paragraph does not apply to credit extended (1) by a foreign branch which at no time during the computation period had credit outstanding to United States residents exceeding \$5 million, (2) to enable the borrower to comply with requirements of the Office of Foreign Direct Investments, Department of Commerce,¹⁰ or (3) under binding commitments entered into before December 1, 1970.

⁹ (a) Any individual residing (at the time the credit is extended) in any State of the United States or the District of Columbia; (b) any corporation, partnership, association or other entity organized therein ("domestic corporation"); and (c) any branch or office located therein of any other entity wherever organized. Credit extended to a foreign branch, office, subsidiary, affiliate or other foreign establishment ("foreign affiliate") controlled by one or more such domestic corporations will not be deemed to be credit extended to a United States resident if the proceeds will be used in its foreign business or that of other foreign affiliates of the controlling domestic corporation(s).

¹⁰ The branch may in good faith rely on the borrower's certification that the funds will be so used.

STATUTORY APPENDIX

Section 25 of the Federal Reserve Act provides in part as follows:

SEC. 25. Any national banking association possessing a capital and surplus of \$1,000,000 or more may file application with the Board of Governors of the Federal Reserve System for permission to exercise, upon such conditions and under such regulations as may be prescribed by the said board, the following powers:

First. To establish branches in foreign countries or dependencies or insular possessions of the United States for the furtherance of the foreign commerce of the United States, and to act if required to do so as fiscal agents of the United States.

Third. To acquire and hold, directly or indirectly, stock or other evidences of ownership in one or more banks organized under the law of a foreign country or a dependency or insular possession of the United States and not engaged, directly or indirectly, in any activity in the United States except as, in the judgment of the Board of Governors of the Federal Reserve System, shall be incidental to the international or foreign business of such foreign bank; and, notwithstanding the provisions of section 23A of this Act, to make loans or extensions of credit to or for the account of such bank in the manner and within the limits prescribed by the Board by general or specific regulation or ruling.

* * * * *

Such application shall specify the name and capital of the banking association filing it, the powers applied for, and the place or places where the banking or financial operations proposed are to be carried on. The Board of Governors of the Federal Reserve System shall have power to approve or to reject such application in whole or in part if for any reason the granting of such application is deemed inexpedient, and shall also have power from time to time to increase or decrease the number of places where such banking operations may be carried on.

[U.S.C., title 12, sec. 601.]

Every national banking association operating foreign branches shall be required to furnish information concerning the condition of such branches to the Comptroller of the Currency upon demand, and every member bank investing in the capital stock of banks or corporations described above shall be required to furnish information concerning the condition of such banks or corporations to the Board of Governors of the Federal Reserve System upon demand, and the Board of Governors of the Federal Reserve System may order special examinations of the said branches, banks, or corporations at such time or times as it may deem best.

[U.S.C., title 12, sec. 602.]

* * * * *

Every such national banking association shall conduct the accounts of each foreign branch independently of the accounts of other foreign branches established by it and of its home office, and shall at the end of each fiscal period transfer to its general ledger the profit or loss accrued at each branch as a separate item.

[U.S.C., title 12, sec. 604.]

Regulations issued by the Board of Governors of the Federal Reserve System under this section, in addition to regulating powers which a foreign branch may exercise under other provisions of law, may authorize such a foreign branch, subject to such conditions and requirements as such regulations may prescribe, to exercise such further powers as may be usual in connection with the transaction of the business of banking in the places where such foreign branch shall transact business. Such regulations shall not authorize a foreign branch to engage in the general business of producing, distributing, buying or selling goods, wares, or merchandise; nor, except to such limited extent as the Board may deem to be necessary with respect to securities issued by any "foreign state" as defined in section 25(b) of this Act, shall such regulations authorize a foreign branch to engage or participate, directly or indirectly, in the business of underwriting, selling, or distributing securities.

[U.S.C., title 12, sec 604a.]

AMENDMENT TO REGULATION M

ISSUED BY THE BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM

PART 213—FOREIGN ACTIVITIES OF NATIONAL BANKS

RESERVES AGAINST EURODOLLAR BORROWINGS

1. Effective January 15, 1971, section 213.7(a) is amended to read as follows:

SECTION 213.7—RESERVES AGAINST FOREIGN BRANCH DEPOSITS

(a) **Transactions with parent bank.** During each week of the four-week period beginning October 16, 1969, and during each week of each successive four-week ("maintenance") period, a member bank having one or more foreign branches shall maintain with the Reserve Bank of its district, as a reserve against its foreign branch deposits, a daily average balance equal to 20 per cent of the amount by which the daily average total of

- (1) net balances due from its domestic offices to such branches, and
- (2) assets (including participations) held by such branches which were acquired from its domestic offices,⁷

during the four-week ("computation") period ending on the Wednesday fifteen days before the beginning of the maintenance period, exceeds the greater of

⁷ Excluding (1) assets so held on June 26, 1969, representing credit extended to persons not residents of the United States and (2) credit extended or renewed by a domestic office after June 26, 1969, to persons not residents of the United States to the extent such credit was not extended in order to replace credit outstanding on that date which was paid prior to its original maturity (see definition of United States resident in footnote 9).

- (i) the lowest corresponding daily average total⁸ for any computation period ending after November 25, 1970, or
- (ii) 3 per cent of the member bank's daily average deposits subject to section 204.5(a) of this chapter (Regulation D) during the current computation period, or the lowest corresponding daily average total⁸ for any computation period beginning on or after January 21, 1971, and after the bank has had a foreign branch in operation for more than 90 days, whichever amount is the lesser:

Provided, That the applicable base computed under (i) or (ii) shall be reduced by the daily average amount of any deposits of the member bank subject to section 204.5(c) of this chapter (Regulation D) during the computation period.

* * * * *

2a. The change provides a means by which a member bank may retain its reserve-free base with respect to its Eurodollar borrowings from its foreign branches by counting within its base the amount of purchases by its foreign branches of certain Export-Import Bank obligations.

⁸ Including the principal amount paid by a foreign branch of the member bank for obligations held by such branch that were purchased by it from the Export-Import Bank of the United States pursuant to its program announced on January 15, 1971, and excluding assets representing credit extended to persons not residents of the United States.

AMENDMENT TO REGULATION M

ISSUED BY THE BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM

**PART 213—FOREIGN ACTIVITIES OF
NATIONAL BANKS****RESERVES AGAINST EURODOLLAR
BORROWINGS**

1. Effective April 1, 1971, Footnote 8 to section 213.7(a) of Regulation M is amended to read as follows:

8/Including the principal amount paid by a foreign branch of the member bank for obligations held by such branch that were purchased by it from the Export-Import Bank of the United States pursuant to its program announced on January 15, 1971, or purchased by it from the United States Treasury pursuant to its program announced on April 1, 1971, and excluding assets representing credit extended to persons not residents of the United States.

* * * * *

2A. The change provides a means by which a member bank may retain its reserve-free base with respect to its Eurodollar borrowings from its foreign branches by counting within its base the amount of purchases by its foreign branches of certain United States Treasury obligations.

B. The requirements of section 553 (b) of Title 5, United States Code, with respect to notice, public participation, and deferred effective date were not followed in connection with this amendment because the Board found that following such procedures with respect to this amendment would be contrary to the public interest and serve no useful purpose.

By order of the Board of Governors, April 1, 1971.

APPENDIX C

AN ALTERNATIVE ESTIMATION PROCEDURE
FOR THE STOCK ADJUSTMENT EQUATION

In chapter four of this thesis generalized least squares is applied to the stock adjustment equation in order to correct for auto-correlated error terms. The transformed equation is of the form:

$$Y_t - \rho_1 Y_{t-1} = \beta_0(1-\rho_1) + \beta_1(X_t - \rho_1 X_{t-1}) + (1-\gamma)(Y_{t-1} - \rho_1 Y_{t-2}) + u_t$$

Fuller and Martin¹ have shown that this procedure leads to biased estimates. In particular they have shown that positive auto-correlation leads to a downward bias in the estimate of the stock adjustment coefficient γ and an upward bias in $(1-\gamma)$.

As an alternative procedure, Fuller and Martin suggest estimating the original equation, and then estimating

$$\widehat{Y_t - \rho_1 Y_{t-1}} = \hat{\beta}_0(1-\rho_1) + \hat{\beta}_1(X_t - \rho_1 X_{t-1}) + \widehat{(1-\gamma)}(Y_{t-1} - \rho_1 Y_{t-2}) + \widehat{\Delta\rho} e_t$$

This procedure yields consistent estimates and leads to a more powerful Durbin-Watson test.

¹Wayne A. Fuller and James E. Martin, "The Effects of Auto-correlated Errors on the Statistical Estimation of Distributed Lag Models," Journal of Farm Economics, Volume XLII (February, 1961), 71-82.